University of Alberta

Translation Technology and Translation Quality: The Use of Machine Translation and Computer-Assisted Translation and Its Implications for Translation Quality Control

by

Haichen Sun

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the

requirements for the degree of *Master of Arts*

in

East Asian Studies

Humanities Computing

Edmonton, Alberta

Fall 2005

Library and Archives Canada

Published Heritage Branch

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque et Archives Canada

Direction du Patrimoine de l'édition

395, rue Wellington
Ottawa ON K1A 0N4
Canada

0-494-09070-7

Your file *Votre référence*
ISBN:
Our file *Notre référence*
ISBN:

NOTICE:
The author has granted a non-exclusive license allowing Library and Archives Canada to reproduce, publish, archive, preserve, conserve, communicate to the public by telecommunication or on the Internet, loan, distribute and sell theses worldwide, for commercial or non-commercial purposes, in microform, paper, electronic and/or any other formats.

The author retains copyright ownership and moral rights in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

AVIS:
L'auteur a accordé une licence non exclusive permettant à la Bibliothèque et Archives Canada de reproduire, publier, archiver, sauvegarder, conserver, transmettre au public par télécommunication ou par l'Internet, prêter, distribuer et vendre des thèses partout dans le monde, à des fins commerciales ou autres, sur support microforme, papier, électronique et/ou autres formats.

L'auteur conserve la propriété du droit d'auteur et des droits moraux qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

In compliance with the Canadian Privacy Act some supporting forms may have been removed from this thesis.

While these forms may be included in the document page count, their removal does not represent any loss of content from the thesis.

Conformément à la loi canadienne sur la protection de la vie privée, quelques formulaires secondaires ont été enlevés de cette thèse.

Bien que ces formulaires aient inclus dans la pagination, il n'y aura aucun contenu manquant.

Canada

ABSTRACT

Computer-based technology designed specifically for translation purposes, in the form of machine translation (MT) and computer-assisted translation (CAT), has made the function or purpose of translation the most important criterion for measuring translation quality. Translation technology cannot yet create knowledge in the form of high quality translation, nor can it significantly improve the quality of human translation. However, MT may outperform human translators in producing translation of a usable quality at high speed and low cost. CAT may propagate human-created quality, whether good or bad, by facilitating the collection, retrieval and exchange of translation-related resources. Due to the leverage of translation technology, it is more important than ever before to give decision-making power to those with a good understanding of quality control issues.

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION 1

1. Computer Technology and Translation 1

2. Computer-Based Translation Technology 3

3. Viewpoints of Users and Developers 3

4. Viewpoints of Researchers 7

5. Translation Technology and Translation Quality 7

6. A Note on Translation Examples 10

CHAPTER TWO: TRANSLATION QUALITY 11

1. The Dual Criteria of Fidelity and Fluency 11

2. The Functionalist Approach 12

3. Translator's Hybrid Role 14

4. Assimilation vs. Dissemination 16

5. Power of the Client 19

6. Translation in Knowledge Management 21

CHAPTER THREE: MACHINE TRANSLATION (MT) 23

1. Early History of MT 23

2. Expectations of MT 24

3. Three MT Approaches 25

4. The Problem of Disambiguation 27

5. Further Limitations of MT 31

6. Ways to Improve MT Quality 33

7. MT for Assimilation 34

8. MT for Dissemination 38

9. MT and Human Translators 39

CHAPTER FOUR: COMPUTER-ASSISTED TRANSLATION (CAT) 42

1. History of CAT 42

2. Translators and General-Purpose Computer Technology 43

3. Translators and CAT 44

4. Terminology Management 46

5. Translation Memory 48

6. The Future of CAT 54

CONCLUSION 55

BIBLIOGRAPHY 58

LIST OF FIGURES

Figure 1. Technology in Translation 3

Figure 2. A Model of Translation Process 15

Figure 3. An Example of MT Misuse 41

Figure 4. Chinese-English alignment suggested by Trados WinAlign 50

Figure 5. Chinese-English alignment finalized by the author. 51

CHAPTER ONE: INTRODUCTION

This thesis attempts a comprehensive examination of translation technology in relation to translation quality. It aims to answer the following questions: What is translation quality? What is translation technology? How does the use of translation technology affect translation quality? What guidelines should be followed when using translation technology in order to ensure translation quality?

Translation quality is a complex issue. It cannot be defined in absolute terms, as there is no standard translation that can be used as the yardstick to measure the quality of any translated text. This thesis argues that the functionalist definition of translation quality is most appropriate in the context of professional translation involving texts of an informative nature. It identifies several factors that determine translation quality, including translator expertise, the use of translation-related resources, and the management of resources and human expertise to achieve optimum performance.

Translation technology is computer-based technology specially designed for translation purposes. It falls into two major categories, machine translation (MT) and computer-assisted/aided translation (CAT). The thesis explores both the history and the state of art of translation technology: How did translation technology originate? What are the objectives of translation technology, and how successful have the developers been in meeting those objectives? What is the future of translation technology?

In its discussion of translation technology, the thesis focuses on its implications for translation quality control. It analyzes various ways in which the use of translation technology may affect translation quality, both positively and negatively. Based on such an analysis, it proposes guidelines for the proper application of computing power and human expertise to maximize the positive gain and minimize the negative impact of translation technology in relation to translation quality.

1. Computer Technology and Translation

The increasingly widespread use of computer technology has transformed the translation profession in the past twenty years. The image of the lone translator sitting in front of a typewriter surrounded by a collection of dictionaries has become obsolete. Large translation companies today coordinate the work of translators scattered across the world, handling high-volume projects of tight schedules involving multiple languages. This is made possible by the employment of a large number of experienced translators who use a wide variety of technological tools including word processing, electronic file transmission, automatic machine translation, and translation support programs such as translation memory and terminology management.

Few would deny the generally positive impact of computer technology on translation. Like many other professionals, translators rely heavily on communication technology in their everyday work. The reception of source texts and related material, the delivery of translated texts, and project-related communications among translators, project managers, subject area experts, and end clients are mostly carried out electronically. Online forums and mailing lists such as LANTRA-L[1] have become valuable vehicles for translators from across the world to exchange ideas and benefit from one another's expertise. Through computer technology, translators have easy access to vast, sometimes free digital resources, which are often easier to navigate and more up-to-date than traditional, paper-based materials. A wealth of information is now available online, including library catalogues such as the Library of Congress; encyclopaedias such as Encyclopaedia Britannica and Wikipedia; dictionaries such as Merriam-Webster and the Chinese-English Dictionary of Modern Usage; terminology databases such as *Termium*, a Government of Canada linguistic databank; and newspaper and magazine archives such as the *New York Times*[2].

Despite the uneven quality of its contents, the Web is easily and almost instantly accessible and therefore often serves as a preferred resource for professional translators, who can rely less on reference books or even domain experts in their research. For example, a translator suspected that "mud-rock flow", the translation for *nishiliu* (泥石流) given in many Chinese-English dictionaries, is not Standard English, and that "debris flow" is the right terminology in English. A simple Google search provided anecdotal evidence supporting this assumption: There were 965 hits for "mud-rock flow", the first 10 of which were all related to China. In contrast, there were 28,900 hits for "debris flow", the first 10 of which mostly described what happened in the United States.[3]

---

[1] LANTRA-L is "a forum for all aspects of translation and interpretation of natural languages". Information about LANTRA-L is available at http://www.geocities.com/Athens/7110/lantra.htm, last accessed on Feb 20, 2005.

[2] The urls for the above-mentioned resources as of Sep 22, 2004:

Library of Congress: http://www.loc.gov/

Encyclopaedia Britannica: http://www.britannica.com/

Wikipedia: http://en.wikipedia.org/wiki/Main_Page

Merriam-Webster: http://www.m-w.com/

Chinese-English Dictionary of Modern Usage: http://humanum.arts.cuhk.edu.hk/Lexis/Lindict/

Termium: http://www.termium.com/site/accueil_home_f.html

New York Times: http://www.nytimes.com/

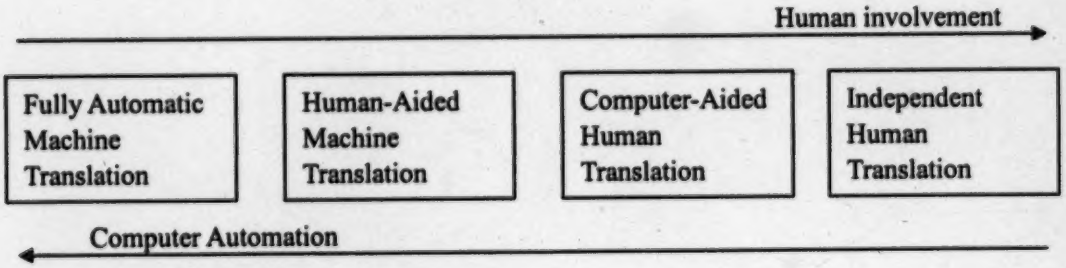
[3] Google search performed on June 15, 2004.

2. Computer-Based Translation Technology

While few, if any, question the benefits of general computer technology to translation, opinions differ when it comes to computer-based technology specially designed for translation purposes, which is the focus of this thesis. Computer-based translation technology roughly falls into two categories, MT and CAT. Broadly speaking, MT is "the application of computers to the task of translating texts from one natural language to another".[1] This inclusive interpretation is adopted by professional associations such as the European Association for Machine Translation, and academic journals such as *Machine Translation*. In popular usage, MT is mostly associated with stand-alone systems that seek to automate the entire translation process. CAT, on the other hand, are software programs designed to assist or aid the human translator by automating certain translation sub-processes such as terminology search and the reuse of previous translations.

MT and CAT have no clear-cut boundary but rather belong to a continuum with varying levels of computer automation and human involvement (Figure 1). Today a translator working with word processing software and accessing various electronic resources such as online dictionaries may still be considered to be producing 100% human translation. The key criterion is whether any part of the target text is automatically generated.

Figure 1. Technology in Translation



(Adapted from Hutchins & Somers 1992)

3. Viewpoints of Users and Developers

Among the main users of translation technology (translation companies and translators), there is no consensus on how translation technology involving partial or total automation of the translation process affects output quality. Translation companies generally think of

[1] European Association for Machine Translation. Retrieved Feb 25, 2005 from http://www.eamt.org/mt.html

translation in terms of projects to be managed in an efficient and cost-effective way and define quality mainly by customer satisfaction. To them, quality basically means keeping the customer happy and has a strong correlation with speed and cost. While some regard the adoption of computer-based translation technology as a strategic advantage, saying the days of purely human translation are numbered, others try to assure potential clients of the quality of their service by saying they use computer aids rarely and with great caution. For example, one translation company claims that the adoption of a particular type of translation technology has improved both quality and productivity:

> ...Transco launched its program to extend the use of Trados translation memory (TM) system in localization aiming to benefit customers by: improved quality by making translation more consistent and use of terminology more accurate; reduced cost by recycling existing translated material as well as taking advantages of repetitions; shorten the translation cycle, and then the whole project cycle.[1]

Another company tries to distance itself from the "corner cutting suppliers" who use MT, saying it will never come close to the quality of professional human translation:

> To cut costs, some suppliers will use machine translation to complete projects and then try to pass the work off as human translation without it ever being read or edited by a real person, let alone a qualified linguist.
>
> Machine translation can be used for gist understanding, but it should never be used for work that is going to be published or where even the lowest level of accuracy is needed.
>
> We never use machine translation. Language is fluid, fluent, varied and diverse. No machine can come close to understanding the nuances of a language, let alone be able to translate those nuances into another language. If you want your company's documentation to "speak" to your colleagues or your clients, you have to use human translation.[2]

Professional translators play a pivotal role in the translation process. Their reception of translation technology determines to a large extent how such technology is applied in their everyday work. They are often too busy translating to write about translation, but their views can be still found in magazines such as the *ATA Chronicle* and *Translation Journal*, and at online forums, electronic mailing lists, and translators' personal websites. Perhaps no one takes the issue of translation quality more seriously than professional translators. They take pride in producing fine work and are sceptical of any translation technology that may compromise quality. Like translation companies,

---

[1] Retrieved June 17, 2004 from http://www.transco.com.cn/Specials/TM_Emplo.htm.

[2] Retrieved Nov 28, 2004 from http://www.gouk.com/translations/quality.html

they tend to think of translation in project management terms and would welcome translation technology that improves the efficiency and profitability of their work - as long as the benefits justify the cost. In reality, the money and time needed for selecting, acquiring, upgrading, learning, and tuning a particular type of translation technology may prove prohibitive. In addition, some translators may be reluctant to embrace translation technology due to their preoccupation with quality, which makes them highly critical of any product that does not put them in full control of the process.

Unsurprisingly, developers have many positive things to say about the type of technology they research and develop as well as the products they sell. Before the late 1980s there had been no clear recognition of the differences between different types of translation technology such as MT whose output must be revised, computer aids for translators, and translation systems that produce rough versions for the occasional non-translator user (Hutchins 1997). Most developers have since given up the search, at least for the time being, for a one-size-fits-all solution and learned to identify different user needs and design products specifically to meet them. They usually focus on either MT or CAT, though a convergence of the two categories of translation technology is already taking place.

In addition to specific product information, a developer's website often provides the company's general viewpoint on translation technology - a viewpoint often dictated by the nature of the technology it develops. SYSTRAN, a leading MT provider for over 30 years, acknowledges the difficulty inherent in the translation process:

> Translation is anything but simple. It's not a mere substitution for each word, but being able to know "all of the words" in a given sentence or phrase and how one may influence the other. Human languages consist of morphology (the way words are built up from small meaning-bearing units), syntax (sentence structure), semantics (meaning), and countless ambiguities.[1]

Despite such difficulty, SYSTRAN claims its MT technology makes business sense due to its numerous benefits:

> Benefits of SYSTRAN's Technology
>
> - Facilitates communication
> - Fast understanding of foreign content, Web pages, documents, work reports, proposals, technical support, etc.
> - Promotes global viability and profitability
> - Builds corporate brand equity in new markets
> - Drives new revenue streams

[1] Retrieved Feb 21, 2005 from http://www.systransoft.com/company/technology/index.html

    - Grows subscriber base
    - Increases and retains site traffic
- Builds knowledge assets
    - Develops conceptual and operational areas of content within companies
    - Manages foreign content
    - Enhances the commercial value of corporate content
- Proven savings in
    - Project turnaround time - increases productivity
    - Manpower
    - Overall corporate budgets
- Return on Investment
    - Reuse of texts already translated
    - Leverage internal customization work for other corporate projects (such as terminology management)[1]

Notably, SYSTRAN does not even mention quality in the benefits listed above. It is not trying to avoid the issue - which is dealt with elsewhere on the website - but is simply recognizing the fact that quality is not among the primary concerns of its potential corporate customers. In contrast, when CAT developer Trados advertises to the community of professional translators the benefits of its "language technology for professionals", it tries to distance itself from MT by echoing the view of many professional translators that MT is almost synonymous with poor quality:

> Q: What is TRADOS?
> A: TRADOS is the premier Translation Memory software. It recycles your translated sentences to make you faster and more consistent. It frees you from repetitive typing and allows you to concentrate your energies on actually translating.
>
> Q: What is Machine Translation?
> A: Machine Translation is simply "vocabulary matching", taking a document in one language and "translating" it into another without human input. These kind [*sic*] of tools are fast, but result in a poor quality translation. A machine cannot understand the subtleties or contexts of language. TRADOS is not a machine translation product.[2]

---

[1] Retrieved Feb 21, 2005 from http://www.systransoft.com/company/technology/benefits.html

[2] Retrieved Sept 22, 2004 from http://www.translationzone.com/sublink.asp?ID=610

4. Viewpoints of Researchers

Translation technology has remained a highly applied field since its inception in the 1940s, and its progress has been documented by researchers who are mostly computer engineers and mathematicians rather than translators or linguists. Unlike marketing materials from developers that tend to over-hype their products, research papers on translation technology accurately report the state of the art in the field. Many of such papers are focused on the development and use of a particular product or technique, such as the stochastic approach to disambiguation (King 1956), a new program for the automatic extraction of terminology pairs (Dagan & Church 1997), or applying a CAT tool (Trados) to a translation project of Windows Help files (Tamaki 2003).

There has also been comprehensive treatment of broad issues in translation technology, especially MT. Warren Weaver is widely believed to have jumpstarted early MT research through his famous memorandum (Weaver 1949), in which he compared translation to cryptography, and through his influence in the United States National Science Foundation. Yehoshua Bar-Hillel, a mathematician who began MT research at the MIT Research Laboratory for Electronics in the early 1950s, was an outstanding critic who explored the nature of some fundamental problems in MT such as ambiguity resolution (Nirenburg 2003). Probably the best known event in early MT research was the publication of the 1966 report by the Automatic Language Processing Advisory Committee (ALPAC), which nearly put an end to MT research funding in the United States for the next twenty years and was perceived by many as proof of the "failure" of MT (Hutchins 1986). The general failure of translation technology development, suggested Martin Kay, might be symptomatic of a gross misunderstanding of the "proper place of man and machines" (Kay 1980). Alan Melby, a linguistics professor at Brigham Young University who was probably the first to use the term "translator's workstation" to describe a CAT system (Melby 1992), has explored machine and human translation by looking at the nature of language (Melby 1995). No survey of literature on translation technology would be complete without John Hutchins, who established himself as an authority on MT history with his milestone work *Machine Translations, Past, Present, Future* (Hutchins 1986) and who has been publishing broad and insightful commentaries on historical and current issues in both MT and CAT for over twenty years. [1]

5. Translation Technology and Translation Quality

In MT and CAT literature mentioned above, quality has been a familiar topic. However, discussion on the topic tends to be fragmented, with no comprehensive treatment of the

[1] All of John Hutchins' writings on translation technology are available on his homepage at http://ourworld.compuserve.com/homepages/WJHutchins/

relationship between translation quality and translation technology. The development of translation technology has been largely driven by the need to increase speed and reduce cost rather than improve quality. Hence quality is a topic that cannot be easily avoided but that seldom takes center stage. On the other hand, the increasing use of computer-based translation technology has redefined the notion of translation quality and reshaped the translation quality control process. For example, the proliferation of MT on the Internet has demonstrated the vast usefulness of poor-quality translation. With their growing popularity, CAT tools not only offer better access to more resources but also change the dynamics of the quality control process, which used to be almost exclusively the realm of translators. All these changes call for a comprehensive examination of translation quality in relation to translation technology in order to answer a few key questions: What is translation quality and what are the factors that determine it? How does the use of translation technology affect these factors, both positively and negatively? What can users and developers do to maximize the positive gain and minimize the negative impact of translation technology in relation to translation quality?

This thesis will address the above questions through an overall examination of the relationship between translation technology and translation quality. In chapter two, it looks at different quality criteria to find out what is generally understood as translation quality and identify the main factors that determine it - translator expertise, use of translation-related resources, and translation project management. In chapters three and four, it surveys the development of MT and CAT, and discusses in detail how the above factors are being affected by the development and use of the two main categories of translation technology. In conclusion, it proposes guidelines for the proper application of computing power and human expertise to achieve optimum translation quality.

With the exception of fully automatic MT without human intervention, the expertise and skills of the translator or translators performing the translation task remain the primary determining factor of the quality of the translation output. Foremost among such expertise and skills is the translator's writing ability. Since translation is a special type of written text, translators must be good writers in their target language in order to produce high-quality translation. Unless technology can turn one into a better writer, it cannot make one a substantially better translator. On the contrary, some translators may argue that translation technology tends to be so complicated as to take up a lot of time that could otherwise be invested in learning languages and honing one's writing skills. It is very difficult, from a professional translator's point of view, to associate translation technology with quality translation, when no amount of technology can yet turn a bad translator into a good one.

Another major factor that affects translation quality is the use of resources. To complete a translation project, translators need access to bilingual and monolingual dictionaries, encyclopaedias and other reference materials as well as the expertise of other people such as colleagues, authors, and subject area experts. Computer technology in general and translation technology in particular serve to facilitate the exchange of ideas

and information, thereby providing better access to resources for those who need them. However, better accessibility does not always lead to higher quality, since it is still up to the humans to effectively use the resources made available by technology. For example, instead of using a paper-based thesaurus, a translator may be able to access a list of synonyms or antonyms faster through the built-in thesaurus of the word processor. It will most probably speed up the translation, but how it will affect quality is less certain. Supposing the translator's ability to choose the most appropriate word from the list remains the same, the quality of the translation will only be affected if the electronic thesaurus is of a different quality from the paper-based one. In fact, quality may be negatively affected if the translator gives up a paper-based thesaurus in favour of an inferior electronic version for the sake of convenience.

In the final analysis, the quality of translation relies on the overall utilization and management of people and resources, an area in which translation technology has had a profound effect. As the discussion of MT and CAT in the following chapters clearly demonstrates, translation technology has been largely driven by the need to optimize the translation process as a business operation. This is not only redefining the concept of quality - with many translation providers aiming for "good enough" rather than "good" quality - but also reshaping the interrelationship of various stakeholders including translation companies, translators and clients. While MT has transformed the translation process by either relegating the translator to a subordinate role (as post-editors) or eliminating the translator altogether, CAT is supposedly designed to aid the work of translators by placing more resources at their disposal. However, a closer look at the CAT functions will indicate that the aid often comes at a cost, not only in terms of time and money but also in terms of control over the use of such resources. In fact, a major change in translation project management brought about by the use of translation technology is the ability of project managers and even clients to micro-manage the translation sub-processes that used to be the sole realm of translators. As the thesis will demonstrate, to ensure that the decision-making power resides with those who understand the translation process is one of the biggest challenges in translation quality control today.

6. A Note on Translation Examples

Babel Fish[1], a free online MT service developed by SYSTRAN, is used for most of the MT examples. Though it does not claim to be able to produce high-quality output, it is very useful in demonstrating certain problems typical of all MT systems. Due to budget limitation, the author has not purchased any recent version of desktop MT software offering some capacity for vocabulary customization - which may or may not result in improved quality of its output. For large specialized MT systems, secondary sources are used. The CAT tool used for demonstration purposes is Trados Freelance 5.5, a product launched in 2001.

Most examples feature translation between English, French and Chinese. In terms of translation technology and even computer technology in general, Chinese is a relatively new language compared with the "well-established" Western languages such as English and French. For instance, Trados provides only partial Chinese language support unless installed on Windows XP. Due to its features such as lack of word spacing and lack of verb tense, Chinese poses challenges that may not exist for translation between major European languages. The thesis quotes many real-life examples from the author's career as a professional translator. In such cases the author has made every effort to ensure that they do not violate the implicit or explicit confidentiality agreement between the translator and the client. Where the texts are not in the public domain, they have been edited to remove client-sensitive information.

---

[1] The name Babel Fish comes from the sci-fi novel *The Hitchhiker's Guide to the Galaxy* by Douglas Adams: "It is small, yellow and leech-like, and probably the oddest thing in the Universe. It feeds on brainwave energy received not from its own carrier but from those around it. It absorbs all unconscious mental frequencies from this brainwave energy to nourish itself with. It then excretes into the brain of its carrier a telepathic matrix formed by combining the conscious thought frequencies with nerve signals picked up from the speech centres of the brain which has supplied them. The practical upshot of all this is that if you stick a Babel fish in your ear you can instantly understand anything said to you in any form of language. The speech patterns you actually hear decode the brainwave matrix which has been fed into your mind by your Babel fish."

CHAPTER TWO: TRANSLATION QUALITY

1. The Dual Criteria of Fidelity and Fluency

The aim of translation activities is to produce a translation of high or reasonable quality, a good target text. But how do we assess the quality of a translation and what can we do to ensure high quality? What criteria do we use to determine that one target text is a good translation and another is a poor one, and what factors in the translation process affect this perceived quality? Translation is generally considered an operation in which the meaning of linguistic units is kept equivalent across languages. In other words, translation aims at the accurate reproduction of the meaning or message of the source text. In assessing the quality of a translation, the target text is compared with the source text to see whether the former is an accurate, correct, and faithful reproduction of the latter. This comparison involves both quantitative and qualitative aspects – whether the target text completely conveys the original message and whether it is accurate "in denotation and in connotation, referentially and pragmatically" (Newmark 1991). Faithfulness or fidelity has long been considered a crucial attribute of a good translation.

Another parameter in judging the quality of a translation is its fluency or intelligibility. A good translation is one that can be easily understood by its target audience. Fidelity and fluency are two correlated but sometimes opposing factors. Giving priority to one or the other has resulted in the dichotomy between literal translation and free translation, which in turn has a direct bearing on how translation quality is judged. The Chinese writer, translator and translation theorist Yang Jiang (b. 1911) compares the translator to "a servant with two masters" (quoted in Chen 2004), held accountable to both the author of the source text and the readers of the target text. Producing high quality translation often requires the translator to play a balancing act, serving the needs of the target audience while remaining faithful to the source text. This can be demonstrated by the practice of Xuan Zang (602-664), a Buddhist monk well known in Chinese history for spearheading the translation of Buddhist scriptures from Sanskrit to Chinese in the seventh century:

> He [Xuang Zang] set down the famous translation criteria that translation "must be both truthful and intelligible to the populace." In a sense, Xuan Zang, with such a formula, was trying to have the best of two worlds—literal translation and free translation. Before Xuan Zang, Dao An during the Sui dynasty [581-618] insisted on a strict literal translation, i.e., that the source text should be translated word by word; Kumarajiva during the early Tang dynasty [618-907] was on the opposite side and advocated a complete free translation method for the sake of

> elegance and intelligibility in the target language. Thus, Xuan Zang combined the advantages of both Dao An's literal translation - respect for the form of the source text - and Kumarajiva's free translation with his own translation practice, aiming to achieve an intelligibility of the translation for the target language readers. (Zhong 2003)

The traditional concept of translation quality, applied mostly in academic or literary translation settings, is often accompanied by the somewhat simplistic assumption that high quality solely depends on the ability and endeavour of individual translators: their linguistic skills, subject area knowledge, stylistic and cultural sensitivity, dedication to work, etc. Quality control is considered an internal process exercised by the translator, with the quality of the output dependent on the effectiveness of the translator's mental activities. "External" factors highly relevant to translation such as client-translator relationship, accessibility of linguistic and other resources, quality of the source texts, and availability of time and money for specific projects, are often taken for granted or ignored. In the case of Xuan Zang, he did have a very strong, dedicated translation team – a group of Chinese monks who had studied Sanskrit abroad. With both subject area knowledge and linguistic skills, they were able to produce high quality translation of Buddhist scriptures. However, their success would not have been possible without a generous and supportive "client", the Chinese emperor Taizong (598-649), who had a pagoda built for Xuan Zang and his collaborators and provided them with all the comfort they needed. The client, the party who commissions the translation, is sometimes the third and most powerful "master" to whom the translator is held accountable. Any discussion of translation quality assessment and control would be incomplete without taking into account the role of the client.

2. The Functionalist Approach

Much of the rapidly growing demand for translation in this age of information explosion and economic globalization falls into the category of professional or commercial translation of pragmatic texts, for which the purpose or function of the target texts is of overriding importance in judging translation quality. A translation is made primarily to fulfill a specific function. People do not translate words or grammatical structures but texts as communicative occurrences. Target texts are therefore not just a simple reproduction of the source texts, but a new version of texts produced for defined target language recipients and for a defined purpose. A good target text therefore conforms to the text-typological conventions in the target language and culture and fulfills the expectations of the target text users in a particular communicative situation.

It follows that we cannot judge quality merely by comparing the source and target texts, but have to understand the target text users and their criteria for assessing how

appropriately and efficiently a text fulfills its purpose in a specific situation. Quality cannot be defined in absolute terms, and there is no standard, 100 percent correct translation that can be used as the yardstick to measure the quality of any given version. Nevertheless, it is possible to determine whether a translation serves a specific purpose, and whether an alternative translation is inferior or superior. To produce a good target text, translators must see the links between the text, the context, the function of the source text and the function of the target text. In addition to having linguistic competence and subject-specific knowledge, translators must know what the clients expect from the text (e.g. maintaining the established company image or creating a new image) and what the end user wants to do with the text (e.g. reading it from beginning to end or using it for reference only). Only then can a translator produce a translation that is appropriately structured and formulated in order to effectively fulfill its intended purpose for a group of people with distinctive backgrounds and needs. For example, the translator working on an updated version of a user's manual for the new release of a product must, in addition to having subject area knowledge and technical writing skills, follow the company style and preferred terminology, maintain consistency with translations of previous versions, and ensure that the style and terminology suit the users in the area where the product is to be sold.

To produce a functionally appropriate translation, translators must understand the supposed reaction of the translation's users so as to act competently in their (and the client's) best interests. Professional translators are expected to have the textual, linguistic, cultural, and domain knowledge needed for the task at hand. Ideally, translators should have near-native fluency in the language they translate from and be native speakers of the language they translate into. However, fluency in a language does not always mean in-depth knowledge of the particular culture of the target audience. For example, though many translators working from English to Chinese can handle both Simplified and Traditional Chinese scripts, they may not be familiar with a particular target group of Chinese-speaking audience, such as people in the Chinese mainland, Taiwan, Hong Kong, Singapore, or overseas Chinese-speaking communities. The same object or concept may be called by different names among various Chinese-speaking populations. Mercedes-Benz is called *benchi* (奔驰) in the Chinese mainland and *binshi* (宾士) in Taiwan. Furthermore, the same word or expression may have different connotations for different cultural groups. In the following example, the English sentence is taken from the English website of a financial services company, and its Chinese translation from the older version of the company's Chinese website the author was commissioned to edit (and ended up retranslating)[1]:

[1] The company's multilingual websites, along with the legal form mentioned in a subsequent example, are available at http://www.newpac.cn/.

> Offshore investment services are largely *unregulated* because they are done outside of any one government's jurisdiction.
> 离岸投资服务基本*不正规*，其行为不受任何政府的管辖。

The author considered it a major error that the word *unregulated* was rendered into *buzhenggui* (不正规), a Chinese expression meaning "irregular" with very strong negative connotations. According to the client, a native Chinese speaker who reviewed the site had no problem with the expression *buzhenggui*, which he considered to be a neutral term. It turned out that the person had never been a resident of the Chinese mainland, the target market of the Simplified Chinese website where the expression *buzhenggui* is often associated with companies producing defective and counterfeit goods. The author changed it to the neutral expression *bushouguanzhi* (不受管制) and retranslated the sentence as follows:

> 境外投资服务基本属于*不受管制的*行业，因为其业务并不在任何一个特定政府的管辖权限之内。

To come up with the correct Chinese translation for Mercedes-Benz, the translator may need access to relevant resources such as country-specific corpora and terminology banks. In such a case, quality control decisions can be made at the project manager's level (e.g. by selecting the right terminology list) and passed on to the translators assigned the task. When the right choice of words requires an understanding of their connotations, as in the example of *buzhenggui*, quality control decisions have to be made on a case-by-case basis and therefore must rely on professional translators or editors familiar with the culture of the target text audience.

3. Translator's Hybrid Role

With translation function as the key quality assessment criterion, the source texts are no longer held sacrosanct but become just one of the many factors coming into play to produce the target texts in order to fulfill a specific function. Some regard this as a major problem with the functional approach to translation quality assessment:

> [It] naturally follows from the crucial role assigned to the 'purpose' of a translation that the original is reduced to a simple 'offer of information,' with the word 'offer' making it immediately clear that this 'information' can freely be accepted or rejected as the translator sees fit. (House 2001, 2)

Whether such an activity and the resulting product can still be considered translation might be open to question:

> Critics argue that in a functionalist approach the ST [source text] is dethroned, the role of the client is exaggerated, and that there is no clear delimitation between translation and adaptation or other textual operations. (Schäffner 1998, 3)

Perhaps in many cases, especially those involving pragmatic texts, there does not have to be a clear delimitation between translation and other textual operations such as adaptation. The translation profession today has evolved far beyond the traditional role of "expressing the sense of [the source text] in another language" (*The Canadian Oxford English Dictionary*, 2001). It has become a "hybrid profession":

> Translators (and interpreters) are experts for interlingual and intercultural communication, and assume full responsibility for their work. They have acquired the necessary professional expertise, above all linguistic, cultural and subject-area competence, and are equipped with suitable technological skills to meet the challenges of the market today and those to be expected over the coming years. On the basis of source material presented in written, spoken or multi-medial form, and using suitable translation strategies and the necessary work tools, they are able to produce a written, spoken or multi-medial text which fulfills its clearly defined purpose in another language or culture. (Schäffner 2000, 25)

Assuming a "hybrid" role, translators must cooperate with other people and make use of various resources in order to complete the translation task. Today more than ever before, translation is a team effort instead of an individual endeavour. Translators play a key role in the translation process, but the quality of the final product depends not only on the translators' professional expertise but also on the effective management of people and resources involved in performing the task. For effective quality control, the translator must interact with other people and access resources at various stages of the translation process, as shown in the simple model designed by the author (Figure 2).

Figure 2. A Model of Translation Process

Stage	People and Resources
Understand the purpose of translation.	The client and/or project manager must be consulted to arrive at a common understanding of what is expected of the translated text.
Analyze the source text (for content, style, text type, suitability for target audience) and define quality control criteria.	The translator may request changes to be made to the source text or the permission to adapt the text during translation.
Prepare the text for translation (key in the text from a hard copy, or remove	This is usually taken care of by the client or the technical staff of the translation

formatting to enable access to the text in a word processor).	company.
Create terminology list (identify technical terms and find their translations).	The client may have a preferred list. The project manager may have a list prepared by other translators for the same client. Such a list may be incomplete or even of low quality by the translator's standards.
Translate (may use word processing and translation technology).	This is translation proper, the single most important part of the translation process. The translator may seek help from colleagues but is wary of any intrusion into this sacred realm by the client or even the project manager.
Check target text against source text (for completeness and accuracy).	This is usually the translator's responsibility but can be delegated to a proof reader, budget permitting.
Check target text itself (for consistency in style and terminology, especially when the project involves more than one translator).	This is the translator's responsibility for one-person projects. For projects involving multiple translators, the project manager is supposed to hire someone to take care of this but often does not.
Polish translation (for preferred usage of the target audience).	This is usually the translator's responsibility. In case the translator is proficient in the target language but not familiar with the culture of the target audience, the project manager is supposed to hire an editor but often does not.
Publish the text (apply or re-apply formatting to the target text).	This is usually done by the technical staff of the client or translation company, who often do not read the target language. The translator is sometimes asked to review the final product to make sure that "everything shows up correctly".

4. Assimilation vs. Dissemination

In formulating quality control criteria, the purpose of a translation – what the users want to do with the target text – is a crucial factor to consider. Basically, translation can be used either for dissemination or assimilation. Dissemination means the target texts are meant for public consumption. They range from company documents for internal circulation to formal publication for a wide audience, such as a full color promotional brochure or a company website. Generally speaking, translation for dissemination has stringent quality control standards, with attention given to style (general style, register

and language variants) and culture (corporate standards, country-specific standards, local suitability). Translators should be allowed some editorial licence, and the translated text should not only be checked against the source text but also reviewed and polished by a writer or editor resident in, or at least originally from, the target language country or region.

Ideally, translation for dissemination is carried out as an integral part of a knowledge management system. This means, among other things, providing translators with a high-quality source text. As a result of the GIGO factor (garbage in, garbage out)[1], the quality of a translation is highly dependent on the quality of the source text; only under rare circumstances can well-trained professional translators with sufficient background knowledge and research capabilities produce a high-quality translation from a poorly written source text. When analyzing the source text, translators sometimes find it necessary to consult the client or author for clarification and possible revision, as suggested by the following legal form the financial services company mentioned in a previous example commissioned the author to translate into Chinese:

> I, *(name)* hereby requests that *XYZ Company,* its agents, or assigns (XYZ Company) to act as agent for purposes of conducting any transaction, transfer or transmission as may be instructed by the undersigned from time to time. In consideration of *XYZ Company* so doing, I hereby:

After receiving the author's inquiry about the ambiguity of the sentence (caused by the third person singular form of the verb "request", the superfluous "that", the ambiguity of the word "assign", and the name of the company in parentheses), the client had its legal officer rewrite the sentence as follows:

> I, *(name)* hereby authorize *XYZ Company*, its agents, or assignees to act as agent for purposes of conducting any transaction, transfer or transmission as may be suggested by the undersigned from time to time. In consideration of *XYZ Company* so doing, I hereby:

The revised source text was concise and clear, enabling the author to produce the following translation:

> 本人，*(姓名)* 在此授权 *XYZ 公司*，其代理人或受托人作为代理，随时依照签署人的建议进行任何交易、汇兑和转移。就 *XYZ 公司*的相关行为，本人在此：

[1] GIGO is originally a computer term which means that if invalid data is entered in a computer program, the output will also be invalid.

For pragmatic texts, high-quality often means more than just being well-written in a general sense; it means the text must be suitable for translation or even tailored-made for translation purposes. Today many large multinational corporations have staff writers produce standard copies, which then get translated into different languages. The writers of such a copy, with translation in mind, may choose to avoid cultural-specific expressions that would not work well in the translated texts.

Translation for assimilation, also known as indicative translation or gist-getting translation, serves the function of giving information. The translation must get the facts and figures straight, but the aesthetic quality of the language is less important. Quality control focuses on the accuracy and completeness of information transfer and may involve consulting subject experts or specialized terminology banks to resolve uncertainties about technical terms, making sure all text has been translated, and checking all figures and dates in the text. Many of these procedures are "mechanical" in nature and as such lend themselves to automation. In fact, translation for assimilation is mostly associated with MT, though fast-turnaround rough translation produced by professional translators and perhaps the work of most amateur translators also belong to this category. For example, the search engine Google.com gives users the option of "translate this page" for web contents in French, German, Italian, Spanish, and Portuguese. By reading the rough English translation produced by Google's free MT service, the user may be able to decide whether the web page has relevant content. A free MT service may not be able to deliver the kind of quality that suits the user's needs; rather the user has to decide how to use the target text based on its quality. The following is the English translation by Babel Fish (http://babelfish.altavista.com/babelfish/tr) of the German description of an auction item on eBay[1]:

> Samsung Digimax 230
> Points Camera
> see act photo!
> I shot with these Camera
> Separate me with heavy hearts from this part, since I transferred to Canon 300 D mirror reflex.
> It concerns no Camera here out of the food SELF-SERVICE market!!!!
> It is not scarcely one year old and has customs traces!!!
> Is technich fully OK ONE
> One supplies: Camera with CF 16 MT map
> Bag, retaining loop,
> Software, USB cable and the cable of the picture
> furthermore Orginal calculation of the Media market and user manual

[1] eBay item number 3820913001. Retrieved on June 19, 2004 from http://cgi.ebay.com/ws/eBayISAPI.dll?ViewItem&category=10575&item=3820913001&rd=1.

Dispatch only with insurance
Data sheet when desired by email

The new your-genuinly plans a one year's warranty for gebrauchtwaren. I cannot grant these as a private person. With the delivery of a requirement you explain yourselves expressly in agreement to do without you legally which is entitled the warranty with gebrauchtwaren completely. Offer only, if you agree with it.

Is the quality of the translation good enough for an English-speaking user to decide whether to bid on the item? In this case the answer is probably yes. By choosing an English language eBay site such as http://www.ebay.com or http://www.ebay.co.uk, the user can access key information provided originally in English: seller profile, current bid, time left, item location, etc. However, if it were a non-standard auction item such as an antique or a big-ticket item such as a car, the user may want to pass it over or obtain a more accurate translation than Babel Fish can possibly provide.

A special type of indicative translation that has become increasingly important in the information age is translation for interchange (Hutchins 2003, 3). This refers to translation used for (informal) communication between individuals such as the exchange of emails. Here again the aesthetic quality of the translation is not important, as long as the people involved can convey what they mean and understand the messages they receive. This type of translation relies almost exclusively on free online MT or inexpensive PC-based MT systems. Whether translation quality can fulfill the users' communication needs depends not only on the ability of the MT system to handle a particular language pair and text type but also on user participation in the quality assurance process: Do they know each other and the topic well enough to spot discrepancies in a message caused by translation errors? Do they follow the manufacturer's recommendations to optimize the MT output (e.g. by customizing the user dictionary and learning to write in a simple, non-ambiguous, MT-friendly style)?

5. Power of the Client

The simple model of translation process discussed earlier applies to most translations for dissemination and some translations for assimilation. Since the professional expertise of the translator can still make or break a translation project, the translator should be involved to varying degrees in most, if not all stages of the translation process. For example, in the publishing stage, the translator must review the final copy to prevent the introduction of new errors when the text is being formatted, especially when the technical staff often do not read the target language. In reality this does not always happen, partly because a final review by the translator may incur an additional (though small) cost for the client. The translator, whose contractual responsibility usually ends with the delivery

of the translation, is sometimes asked to review the published copy as a courtesy. It is perhaps unrealistic to expect the translator to maintain the same professional standards when doing unpaid work, especially considering that translators, unlike writers, often do not receive credit for their work, even though translation can be a highly creative endeavour.

Since translation today is almost always a team rather than individual project, quality control depends on the interaction of people, technology and information resources. Effective cooperation based on the proper allocation of power and responsibility among various stakeholders, especially with regard to the pivotal role of translators, goes a long way in ensuring the high quality of the translation output. Yet translators may not always have the authority (or even the incentive) to fulfill their quality control function. Translation has long been an underappreciated profession and there seems to be a lack of due respect for translators:

> ...since everybody uses language every day, a lot of people feel competent to comment on it. [There are]...some traditional assumptions or illusions laypeople have about translations, i.e. the assumption that translation comes naturally to everybody who knows more than one language, the assumption that a translation is a mirror-image of the source text, the assumption that meanings can be read from the forms. It is particularly this last assumption which is reflected in frequently heard instructions to a translator to just translate what is there and not bother about the rest. (Schäffner 1998, 44)

On the one hand, translators are often told to "just translate", i.e. confine themselves to rendering faithfully whatever is written in the source text. On the other hand, those who commission the translation also make translators responsible for rendering the source text in such a way that it fulfills the needs of specific users in a specific situation. Translators may find it difficult to please "two masters" at the same time, to make the translation both faithful to the source text and functionally appropriate. No wonder the act of translation has often been compared to "dancing in shackles". In view of the hybrid role the translator has to take on nowadays, translation should no longer be considered in terms of simple text reproduction, but should be considered a special kind of text production in the broader context of knowledge management. Translators should therefore be treated as knowledge workers and accorded a higher status than they have traditionally enjoyed.

Clients, who are in a position of great power because they commission the translation, may have very diverse viewpoints as to how the translation is to be done. Many corporations have very definite ideas on what a translation should read like. Each has its own corporate identity and translation practice, and this becomes part of the yardsticks used when assessing the quality of a translation. However, if clients have the power to decide the function of the translation, translators must have or at least share the

power to decide how the function can best be fulfilled. In reality clients may be unwilling to give translators the needed decision-making power in this respect. Translators often have to make difficult choices, for example whether to use the established, poor translations for certain terms or expressions provided by the client or to use better, more accurate translations of their own. If those in power take the wrong decisions, the more efficiently those decisions are carried out, for example by means of translation technology, the worse the quality of the output.

Translators used to work quite independently in the sense that the client did not dictate what dictionaries or what brand of typewriters they should use. However, as translation becomes more integrated with the document production system, clients are gaining more control over translators' work. Instead of giving translators a list of preferred terminology, some clients would require the translator to own a particular software program compatible with their own terminology management package, and then impose their established terminology for various languages, which may be inferior to a terminology list produced by the translator. It would be reasonable to assume that a large translation company with staff terminologists may be able to improve quality by using such a program, whereas a client with no translation know-how may impair quality by using it indiscriminately.

6. Translation in Knowledge Management

In a globalizing world, translation has become an integral part of the knowledge management system in many companies and organizations that have to communicate to a worldwide audience. To understand how a change to the translation process, such as the adoption of a translation technology package, will affect the quality of the final output, it is necessary to examine how that particular change will affect the way people work together and the way information is created and distributed. Most importantly, the pivotal role of translators in quality control should be strengthened rather than weakened. Translators should be treated as knowledge workers and be given both power and responsibility in doing their work. They should be viewed as skilled professionals rather than subordinates to the more important work of executives and knowledge producers. This will allow the translators to act as an intermediary in the knowledge value chain, interact productively with other people and engage in the creative process such as inventing neologisms in the target text, help establish standard usage, and reuse finalized knowledge products to decode new knowledge. The future of translation quality control will be shaped, among other things, by the development of a knowledge management system with translators in charge of the translation component. Client education, a long-time endeavour of translators, used to mean the client should leave the translators alone because they know their job better than anyone else. Now it means the translators must

communicate the best quality control practices to other stakeholders such as writers, computer technicians, project managers as well as clients.

Quality does not exist in a vacuum in today's highly competitive translation market. It is only one of the elements comprising the overall performance of a particular translation project. Two other important elements are speed and cost, as quality takes both time and money. For translation project managers, quality may be one priority, but overall performance is often more important – they are always looking for ways to produce translation faster and cheaper, preferably without compromising quality. This has been the main driving force behind the development of translation technology. What mainly concerns technology developers may not be so much how to improve quality as how to improve efficiency and still maintain acceptable quality. The next two chapters examine MT and CAT to determine how the use of translation technology affects quality maintenance and improvement, and what best practices should be followed in order to achieve optimum quality.

CHAPTER THREE: MACHINE TRANSLATION (MT)

1. Early History of MT

MT is generally understood to be the automatic translation of texts from one natural language to another by means of a computer system, with or without human involvement. People want a dream machine that allows seamless communication among people who speak different languages, such as the universal decoder in the *Star Trek* universe. MT is commercially important because human translation can be slow and expensive. It is also scientifically important, providing a testing ground for various ideas in linguistics, computer science, and artificial intelligence, and calling for an integrated approach because translation involves the application of the full range of human knowledge, a crucial fact long known to translators but yet to gain wide recognition.

The history of operational MT dates to the mid-20th century, right after the invention of the modern digital computer and its successful application in code-breaking in World War II. In the Weaver Memorandum of 1949, a landmark document that generated great enthusiasm for early MT research in the US and Europe, Warren Weaver compared translation to cryptography:

> … one naturally wonders if the problem of translation could conceivably be treated as a problem in cryptography. When I look at an article in Russian, I say: "This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode." (Weaver 1949)

In Weaver's opinion, there existed a language-neutral message encoded behind any text, and MT could just be a process of deciphering the encoded message. Not everyone accepted such a simplistic view of translation. Two years before the publication of the memorandum Norbert Wiener, the American mathematician who established the science of cybernetics (and who had the opportunity to learn some Chinese, a language vastly different from English, while working at Tsinghua University as a visiting professor in the mid-1930s) wrote in a reply to Weaver: "I frankly am afraid the boundaries of words in different languages are too vague, and the emotional and international connotations are too extensive to make any quasi-mechanical translation scheme very hopeful" (quoted in Weaver 1949).

With large grants from government, military and private sources, MT research groups started work in many countries. Early designers of MT systems typically consisted of computer engineers and mathematicians who aimed at nothing less than fully automatic high-quality translation (FAHQT) of general texts. However, their ambition

and optimism were often based on some dubious assumptions about the nature of language and of translation, such as the notion that meaning can exist independent of the text, or that "the translation of the whole is some not too complex function over the translations of the parts" (Somers 1992). Any professional translator would have pointed out that translation is more art than science and that high quality cannot be achieved by mechanically following a set of rules to break the source text into pieces and re-assemble them in the target language. However, professional translators were largely absent from early MT designer teams.

The simplistic design principle, the relatively primitive computer technology, and the underestimation of the difficulty of the task coupled with unrealistic expectations resulted in disillusionment with MT after many years of efforts. The age of optimism officially came to an end with the 1966 report by the Automatic Language Processing Advisory Committee (ALPAC), a committee set up by major US sponsors of MT research including the Department of Defence, the National Science Foundation, and the Central Intelligence Agency. The report concluded that there was no immediate prospect of MT producing useful translations of general texts without human assistance (Hutchins 1986). At about the same period some apocryphal stories of computer-generated translations began to circulate. According to one such urban legend, a system used by the US Central Intelligence Agency translated "out of sight, out of mind" into the Russian equivalent of "blind idiot" or "invisible insanity" (Budiansky 1998). Underlying such stories was the idea that MT was worth nothing but a good laugh.

The conclusions of the ALPAC report were not all negative. In fact they spelled out the limitations of the MT systems and pointed out ways of improvement. MT research continued with more practical goals. It gradually became accepted that fully automatic high-quality translation of unrestricted texts without any form of human assistance would not be achievable in the foreseeable future. MT researchers started to look at ways to develop usable and useful MT systems even if they fell short of this goal. 1969 saw the testing of the first SYSTRAN MT system, which has been providing Russian to English translations to the Foreign Technology Division of the US Air Force since then.[1]

2. Expectations of MT

Even to this day the underestimation of the complexity of translation remains a negative factor affecting the translation profession and creating problems for quality control efforts on the part of translators. In his 2000 State of the Union Address former US President Bill Clinton claimed that "soon researchers will bring about devices that can translate foreign languages as fast as we can talk." Translators in the US were outraged, and the

[1] Information provided by the SYSTRAN website. Retrieved June 22, 2004 from http://www.systrangroup.net/About/PastPresent.html.

American Translators Association sent a letter to Clinton pointing out that machines "that can translate as fast as we can talk" are still a long way off (Li 2002). Translators, as individuals or organizations, often find it hard to gain appreciation for their skill and value and feel the acute need to promote their professional image and educate their clients. Non-translators, especially people who are monolingual, often regard translation as a simple, straightforward process whereby a string of words in one language are replaced by a string of "corresponding" words in another. This notion accounted for the high expectations placed on early MT systems and partially explains why it has been difficult for translators to gain the decision-making power needed for effective quality control in the face of increasing automation of the translation process.

In order to find ways to improve the quality of MT output, it is important to understand why translation is difficult to automate. MT designers have always been realistic in the sense that they do not expect computers to do everything human translators do. Human translators often have to produce a text that is interesting, humorous, inspiring, persuasive, elegant, poetic, etc. based on the nature of the source text. MT systems, on the other hand, only handle the basic part of the translation job: taking a pragmatic text in one language and producing a text in another language which contains the same information. MT systems are designed to handle technical documentation or general texts of an informative nature. MT output should contain the same information as the source text, but not necessarily the same aesthetic qualities as one would expect from a translation of Shakespearean plays. Human translators may find it necessary to adapt the target texts or add translator's notes in the case of cultural or knowledge barriers between the readers of the target language and those of the source language, and to coin new words in the target language for new terminology without established translations. MT is not expected to play such a role. Yet fundamental problems remain that constrain the quality we can get from MT. MT systems are after all devices for following rules. A brief examination of the basic MT architectures will illustrate the difficulty of reducing the complex task of translation to a set of rules that can be processed by computers.

3. Three MT Approaches

There are three traditional approaches to MT: direct, transfer and interlingua (Hutchins 1986). The first, simplest and most direct approach was adopted by some of the earliest MT systems, such as the Russian-English system jointly developed by IBM staff and MT researchers at Georgetown University and publicly demonstrated in 1954 (Hutchins 1994). There are no intermediate stages in the translation process, with words in the source text directly replaced by their "equivalents" in the target language. The simple procedures usually consist of morphological analysis of the source text, lexical transfer of

content words, some subject-verb-object rearrangements, and morphological generation of the target text.

Direct MT is designed for a single language pair, and its performance depends heavily on the syntactic, semantic and lexical similarities between the two languages. The system does not carry out a detailed analysis of the source text but operates on a word-for-word basis. Designers of direct MT usually try to integrate as much linguistic data as they can into the dictionary to make up for the systems' lack of analytical capabilities. The direct approach, though rather "primitive", has the advantage of being highly robust, capable of generating a translation despite unresolved syntactic or semantic problems.

The transfer approach, still adopted by many high-end MT systems today, involves three main stages: analysis, transfer, and synthesis or generation, with the transfer bridging the gap between the output of the source language parser and the input to the target language generator (Jurafsky & Martin 2000). In the first stage, the source text is analyzed morphologically, using a source-language dictionary and grammar rules to produce an abstract representation of the source text. In the transfer stage, the source-language representation is transferred both syntactically and lexically into a target-language parsing tree, using restructuring rules and a bilingual dictionary. In the final stage, the target-language parsing tree is turned into the final, surface structure using target-language dictionary and grammar rules.

Compared with the direct model, transfer systems incorporate complete linguistic theories and a large linguistic database comprising monolingual and bilingual dictionaries, and both the theoretical principles and database can be modified or upgraded to improve output quality. The transfer model thus employs a set of rules for the lexical and structural transformation of the source text to produce the target text. In addition, the analysis and generation components, if they are kept separate, can be reused for other language pairs.

From a translator's point of view, the transfer model still appears a bit too "mechanical" and works best with texts that lend themselves to literal or word for word translation. Unlike computers, translators do not deal with words and phrases as separate entities. The basic unit processed by translators is the sentence. They usually read the source text sentence carefully to arrive at a thorough understanding, extract the meaning from the words, and then create the target text to convey that meaning. They always see words in context, which in most cases define the exact meaning of a word. The process of extracting the overall meaning of a sentence may suggest the existence, however transient, of an abstract, language-independent representation of meaning in the translator's mind.

This idea of a language-independent representation of meaning lies behind the third major MT approach, interlingua, which has only two stages: from the source text to the abstract representation of meaning called interlingua, and from interlingua to the target text. While the transfer approach depends on contrastive knowledge of a specific language pair, the interlingua, being language-independent, can be used for any language (Hutchins 1986). The interlingua approach is evocative of an analogy between translation

and reincarnation: just as the soul gets reincarnated in different bodies, the meaning of the source text gets reborn in various languages through translation. The ultimate question is whether there exists a soul that can be separated from the body, or with regard to translation, whether we can find an abstract representation of meaning that transcends all languages. To design a system of meaning representation that applies to all languages proves a daunting task, and the interlingua model remains of more interest to research than to practical use (Austermuhl 2001). Restricting the source text to a specific language domain makes this model easier to implement by enabling the designer to conduct a thorough semantic analysis of the domain and come up with a relatively small set of interrelated thematic roles to construct the interlingua.

MT systems are usually not based on a single theoretical model but adopt various working strategies to achieve optimum performance. For example SYSTRAN (acronym for System Translation), founded in 1968 by Peter Toma, previously a member of the MT team at Georgetown University, was originally built using the direct approach to MT, with its translation process relying mainly on bilingual dictionary look-up (Hutchins 1992, 176). It has since evolved to become a mainly transfer-based MT:

> Transfer is a stage in the machine translation process in which the results of the analysis of the source language sentence are reordered according to a set of rules that embodies the structural relationship between the source and target language syntax. Transfer is a step carried out in so-called "transfer MT systems" such as SYSTRAN. SYSTRAN has introduced implicit transfer methods into the redesigned system to simplify and speed the transfer process. The motivation for this is that some types of local expressions and verbal constructs have unique and complex internal structures and, thus, are hard to describe using transfer rules. Implicit transfer establishes parallel source and target descriptions for these phenomena, then aligns and generates a correct syntactic structure in the target based on the target description. (Flanagan & McClure 2002)

4. The Problem of Disambiguation

Whatever approach an MT system adopts, it will run into various problems and has to devise strategies to deal with them. To translate a sentence, the system has to analyze a string of words and produce an abstract representation of the content of those words, but natural languages are full of lexical and structural ambiguities, making it difficult to work out the exact content. As a result, a string of words may have many possible representations, and translation involves constant disambiguation efforts. The following examples of translation from English to Chinese and French use the free online MT

service Babel Fish powered by SYSTRAN (http://babelfish.altavista.com/babelfish/tr)[1]. Babel Fish, launched in 1997, often does a better job with French than with Chinese – Chinese was added in 2001 and is perhaps not as fully incorporated into the system as other, well-established languages such as French.

1. Perform the check.

执行支票。

Exécutez le contrôle.

2. Cash the check.

兑现支票。

Encaissez le chèque.

The polysemous English word *check* has to be disambiguated in order to find the right translation into the target languages (*jiancha* (检查)/contrôle or *zhipiao* 支票/chèque). This type of disambiguation can be achieved by assigning semantic features to lexical terms and defining rules about the acceptable interrelationship between these features. Thus a verb may "select" a given sense of the noun that acts as its object. In this case, we may dictate that the direct object of *perform* should be an action noun (*jiancha*/contrôle), and the direct object of "deposit" should be a concrete noun (*zhipiao*/chèque). However, the use of semantic classification to resolve word sense ambiguity does not work in all cases. A natural language is too complex to break into neatly defined, well-ordered semantic units, and the usage of the units cannot be expected to fully conform to a set of compatibility rules. The disambiguation of the polysemy *spring* in the following examples proves difficult for Babel Fish in both its Chinese and French translations:

1. The spring rusted.

春天生锈。(Chinese translation by Babel Fish)

Le ressort s'est rouillé. (French translation)

2. Spring has come.

春天来。(Chinese translation by Babel Fish)

[1] Unless otherwise indicated, all Babel Fish translations were performed on April 8, 2004.

Le ressort est venu. (French translation)

In example 1 the word *spring*, used in the sense of metal coil, should be rendered into *ressort* and *tanhuan* (弹簧) in French and Chinese respectively. In example 2 the word refers to the spring season and should be translated into *printemps* and *chuntian* (春天) respectively. We may attempt to assign the noun *spring* to different semantic categories such as "physical object" for metal coil and "time period" for the spring season. Thus only a physical object can rust, but not a time period. However, the verb *come* creates a problem – it is compatible with almost all noun categories one can think of. An obvious and relatively easy alternative is to disambiguate by restricting the input to a specific subject area. In a general text the noun "spring" usually refers to the season, whereas in a technical manual it is more likely to refer to the metal device. Somehow Babel Fish, typically used on general texts for gist-getting purposes, seems to have different preferred subject domains for Chinese and French, at least with regard to the word *spring*.

Lexical ambiguity is often compounded by structural ambiguity, the indeterminacy of meaning due to the different structures that can be assigned. This creates, for example, the difficulty of anaphora resolution, or deciding what other part of the text a particular word (usually a pronoun) refers to. In the following two examples, it is necessary for the MT system to identify the antecedent of the pronoun "they", since both Chinese and French distinguish gender in third person plural pronouns – *tamen* (他们)/ils vs. *tamen* (她们)/elles – whereas English does not.

1. I do not like my sisters because they like to gossip.

我不喜欢我的姐妹因为他们喜欢说闲话。

Je n'aime pas mes soeurs parce qu'elles aiment bavarder.

2. I do not like my sisters. They like to gossip.

我不喜欢我的姐妹。他们喜欢说闲话。

Je n'aime pas mes soeurs. Ils aiment bavarder.

In example 1, Babel Fish again does a better job with French than with Chinese by making the correct choice between "elles" and "ils", but in example 2 "ils" is apparently used as the default choice in the absence of cross-sentence context analysis. Context analysis does not go beyond the sentence level in current MT systems because it would be difficult to tell the computer where to look for relevant information to resolve the ambiguity. On the other hand, the above examples also indicate that, based on an

understanding of how MT works, we may phrase the source text differently to produce a higher-quality MT output.

Since translation is a complex activity that involves the full range of human knowledge, decoding of the source message often depends to some extent on information not explicitly available in the words that make up the message. The dependence on extra-linguistic situation to disambiguate meaning has long been identified as a major obstacle to overcome in MT research:

> Understanding the "linguistic" meaning of a text does not guarantee the ability to process the text correctly: "linguistic" meaning and "situational" content (the state of affairs) are quite different things not always linked by a unique (one-to-one) correspondence. (Kulagina & Mel'cuk 1967)

When disambiguation has to rely on real-world knowledge, context-based analysis will prove insufficient, as in the following classic example by Yehoshua Bar-Hillel (Nirenburg 2003):

> 1. The pen was in the box.
> [The writing instrument is in the container.]
> 笔是在箱子。
> Le stylo était dans la boîte.
>
> 2. The box was in the pen.
> [The container is in the playpen.]
> 箱子是在笔。
> La boîte était dans le stylo.

In the second sentence, Babel Fish mistranslated the word *pen* in both Chinese and French. To disambiguate *pen* correctly, to decide that it refers to an enclosed space rather than a writing instrument, requires common sense reasoning based on real-world knowledge. To put this knowledge at the disposal of the MT system, it must be supplied with a "universal encyclopaedia". Nothing less than "a science dealing with human thinking" is needed:

> The study of correlations between situations (physical reality) and meanings (thoughts about realities) constitutes, in effect, a science dealing with human thinking, with human cognition of the world, with ways the human brain extracts and stores information about this world. Of all real situations only very few (highly special, hardly occurring in everyday practice) are described by exact

> sciences. ... We must proceed to build up a regular encyclopaedia of the man-in-the-street's knowledge about the everyday world, or a detailed manual of naive, home-spun "physics" written in an appropriate technical language. It is clear that such a task exceeds the limits of linguistics. (Kulagina & Mel'cuk 1967)

Since then there has been some progress in creating general knowledge bases and common-sense reasoning engines, such as the Open Mind database developed at MIT's Media Lab (Denison 2003) and the Cyc[1] Project (Wood 2002). Nonetheless, the use of explicit representation of real-world knowledge in MT systems to arrive at an actual understanding of the source text, an approach known as knowledge-based MT, has yet to result in substantial improvement of output quality.

5. Further Limitations of MT

In the previous examples, Babel Fish often fails to resolve ambiguities that would not cause any difficulty even for novice translators. None of the current MT systems, including those custom-built for corporate clients, claims to have the capability to tackle problems that demand the skills of an experienced translator, as shown in the following example (Sun 1998, 29):

> 中国饮茶的*风尚*，到了第七世纪的唐代，已经相当*盛行*了。
>
> In the seventh century of the Tang dynasty, the Chinese *prevailing custom* of drinking tea was *in vogue*. (student translation)

The book uses examples like the above to illustrate the common errors made by students in their translation exercises. For some students, translation simply means finding the right words or phrases in the target language to convey the meanings of words and phrases in the source text, and then stringing these words together to form the translated sentence. These students have to be reminded to stop "translating like a machine" and take some time to review and edit the translated sentence from the perspective of a writer in the target language. The absence of the reviewing stage, either on the part of student translators or MT systems, will compromise the quality of the output. In this example, the subject of the Chinese sentence, *fengshang* (风尚) and the verb, *shengxing* (盛行) happen to be homosemic and require no disambiguation. The student translator rendered them into "prevailing custom" and "in vogue" respectively. However, it is obviously redundant to say that a "prevailing custom" is "in vogue". Babel

[1] Derived from the word *encyclopedia*.

Fish committed the same error as the student translator (and also had some problem with word order):

> China drinks the tea the *prevailing custom*, to the seventh century Tang Dynasty, quite has already been *in vogue*.

The book provides the revised translation as follows:

> By the Tang dynasty in the seventh century, tea-drinking had become very popular in China.

It should be noted that there is no obvious redundancy in the original Chinese text, so the redundancy problem in the translated text cannot be blamed on poor-quality input. Most student translators, once made aware of the problem, are capable of dealing with it by editing and polishing their initial translation. On the other hand, MT systems lack the mechanism to eliminate such redundancy because they are built on the assumption that translation of the whole can be achieved by adding up translations of the parts, without understanding the meaning of the translation output.

The lack of learning capability has hampered MT performance since the very beginning, as demonstrated by the inefficient "tuning" process tried on some of the early systems. The apparent success of the first public demonstration of MT jointly developed by Georgetown University and IBM in 1954 was misleading, as the system had been tuned to a set of pre-selected sentences. Given another set of sentences, the system produced poor results and had to be re-tuned. After re-tuning, the system might work well with the new set of sentences, but could no longer translate the first set of sentences properly. What made the process not really worth the trouble is that it took longer to tune an MT system for a new text than to have the text translated by a human translator to produce a target text of equal or higher quality (Melby 1995).

As the refinement of current design technology seems unlikely to ever achieve fully-automated high-quality translation, some people place their hope on progress in artificial intelligence, especially with regard to knowledge representation and inference (Champollion 2001). However, it may take quite some time for computers to acquire enough artificial intelligence to do the professional translator's job – or to produce excellent pieces of writing, for "the translator is nothing more than a skilled writer who takes ideas from one language and creates them anew in another" (Hunt 2002). For the time being, in order to achieve high quality, we have to give up fully automatic translation and introduce some kind of human involvement. This can take place before the translation starts (using controlled input), during the translation process (human-computer interaction to resolve ambiguities), or after the translation is done (post-editing of MT output).

6. Ways to Improve MT Quality

One way to improve MT quality is to use human translators as "post-editors" to edit and polish the raw MT output. However, if there are too many errors in the MT output, post-editing may require as much effort as normal human translation. In addition, many professional translators resent editing what they regard as a poor translation and would rather retranslate the whole thing. It can be especially frustrating for post-editors when they have to correct the same types of MT errors over and over again. Research has been conducted to make the post-editing process interactive, so that feedback from the post-editors can be used to improve the system's performance (Somers 1992). Unfortunately the interactive mode is far from a standard feature in commercial MT systems.

Translation service providers sometimes offer MT with quick human post-editing as an inexpensive alternative to professional human translation. However, when professional quality is required, it is often more cost-effective to use pure human translation than to use post-edited MT, for the same reason that it often makes more sense to commission a translation by a professional translator than a translation by an amateur translator and the editing service of a professional translator. The so-called 80/20 rule certainly applies to the translation process: the translator usually spends 80 percent of the time on 20 percent of the text, and it is this crucial 20 percent that often gets messed up by amateur translators or MT systems.

Another effective strategy for improving MT quality is to control the input. Some text types (such as special-domain technical documentation) are more MT-friendly than others (such as creative literature). By restricting the source text to a sublanguage with its peculiar vocabulary, syntax and universe of discourse, a custom-built MT system can produce high–quality output with minimal post-editing. A well-known example is the METEO system first developed in 1977 at the University of Montreal to translate weather forecasts from English to French. METEO now performs 91% of the workload of Environment Canada's translation team in Ville Saint-Laurent, Quebec. In 1996, the U.S. National Weather Service used METEO for the French translation of weather forecasts, watches, warnings and advisories issued for the Atlanta Olympic Games. "METEO 96 translated more than 305,000 words in 16 days with better than 93% accuracy, a task which would have taken a human translator 7½ months. Output was edited by three bilingual Canadian meteorologists."[1] The success of the METEO system depends on the fact that weather forecasts consist of very limited vocabulary and phrase types with very little ambiguity involved:

---

[1] Information provided by the website of John Chandioux Consultants Inc. Retrieved on June 22, 2004 from http://www.chandioux.com/press_meteo20_eng.html.

Whitecourt-Edson-Fox Creek-Swan Hills
Hinton-Grande Cache.
Tonight..Cloudy periods. 30 percent chance of showers early this evening. Clearing this evening. Low 5.
Monday..Sunny. Fog patches in the morning. High 22. UV index 7 or high.

Whitecourt-Edson-Fox Creek-Swan Hills
Hinton-Grande Cache.
Ce soir et cette nuit..Passages nuageux. 30 pour cent de probabilité d'averses tôt ce soir. Dégagement ce soir. Minimum de 5.
Lundi..Ensoleillé. Nappes de brouillard en matinée. Maximum de 22.
Indice UV de 7 ou élevé.[1]

Most technical documents fall into the category of special languages, which have a specialized vocabulary just like sublanguages but feature more structural freedom. To optimize MT output it is often necessary to transform the source text into a "controlled language" with a circumscribed range of syntax as well as vocabulary. Pre-editing has an additional advantage over post-editing when a single document needs to be translated into several languages. At some major multinational corporations that sell products with accompanying documentation in multiple languages, it has become standard practice to train technical writers to use controlled language. At Xerox, for example, technical authors are obliged to compose documents in the so-called Multinational Customized English, with strict rules on the use of terms and the construction of sentences (Hutchins 1999). IBM has developed an authoring tool called EasyEnglish to address structural ambiguity, thus facilitating the machine translation of its manuals (Bernth 1998). In those companies that recognize the advantages of using controlled language, translation has become an integral part of the technical authoring and publishing process.

7. MT for Assimilation

For indicative translation, which offers a rough idea of the source text content rather than an accurate rendition, MT might be a good choice as long as the users can get what they want from the raw MT output – obtaining information cheaply and quickly, with reasonable accuracy. Users of indicative translation can be specialists in a given area,

[1] Bilingual texts retrieved Aug 8, 2004 from Environment Canada's website at <http://www.weatheroffice.ec.gc.ca/forecast/textforecast_e.html?Bulletin=fpcn16.cwwg> and <http://www.weatheroffice.ec.gc.ca/forecast/textforecast_f.html?Bulletin=fpcn76.cwwg>.

who care little about style and are not easily misled by mistranslation. A typical example is for a scientist to obtain a rough translation of articles in foreign-language journals in order to keep abreast of the latest development in his or her research field. If a document appears interesting enough, investment in human translation might be justified.

In recent years the phenomenal growth of the Internet has produced a high demand for real-time online translation. Again high quality is not essential, at least not as important as high speed and low cost. Today there are many PC-based MT programs marketed for the translation of Web pages and electronic mail, and cheap and even free online MT services such as Babel Fish, which are mostly used by monolinguals on general texts for gist-getting purposes. In the previous examples Babel Fish often fails to produce translation of the kind of quality we normally expect from a human translator, yet it is not the mandate of the free MT service to provide a "polished" translation:

> As an automatic translator, Babel Fish works best when the text you wish to translate uses proper grammar. Slang, misspelled words, poorly placed punctuation and complex or lengthy sentences can all cause a page to be translated incorrectly. Expect Babel Fish to allow you to grasp the general intent of the original, not to produce a polished translation.[1]

The MT service can prove helpful for gist-getting purposes, as shown by the previous example of the German-English translation of the listing information of an eBay item. The following is a Chinese message and its English translation by Babel Fish:

> 我多次给您发传真，不知收到否？
>
> 依据去年底我校与贵区独立中学高中校友好交流协议，今年将抓紧时间双方互派学生进行短期交流。我们相信这项交流活动在您的指导与支持下一定会成功圆满！
>
> 5月6日上午，我校将举行九十华诞庆典，敬请您在百忙之中光临。您何时光临请尽快给我们发传真或发信来。我们热切地盼望和期待您的到来，静候您的回音。
>
> 最后，衷心地祝愿您身体健康，生活愉快。祝愿贵区教育教学事业发达！
>
> I send the facsimile many times to you, did not know receives otherwise? Based on the end of last year I the school and the expensive area independent middle school high school school friendly exchange agreement, this year will grasp time both sides mutually to send the student to carry on the short-term exchange. We believed this exchange certainly can succeed completely in under yours

[1] Retrieved on July 30, 2004 from Babel Fish's website at <http://www.altavista.com/help/babelfish/babel_help>.

instruction and the support! On May 6 the morning, my school will hold 90 birthday celebrations, will ask respectfully you in spite of being very busy the presence. Does your when presence please as soon as possible send the facsimile to us or sends a letter. We earnestly hoped and anticipated your arrival, awaits calmly your echo. Finally, heartfeltly wishes your health, the life to be happy. Wishes the expensive area education teaching enterprise to be developed!

The translation by Babel Fish, though by no means fluent, provides the reader with the following key points of the original message:

- The sender has sent several faxes without receiving any reply.
- The sender refers to a certain exchange agreement signed the previous year, probably between the sender and the recipient.
- The sender suggests both parties carry out the agreement by sending short-term exchange students.
- The sender invites the recipient to come for his/her school's 90th anniversary on the morning of May 6, and requests a quick reply by fax or mail.
- The message is written in a cordial tone.

It is not inconceivable for the recipient to use Babel Fish to translate the original message and then compose a reply based on the rough translation, though in this particular case the original Chinese text was a fax message, which would have to be converted into electronic form to be fed into any MT system. Instead, the recipient commissioned a professional translation by the author:

I have sent you faxes several times and I wonder if you have received them.

By the exchange agreement signed between our school and the senior high section of your independent school district, both sides will be sending short-term exchange students this year. We believe that with your leadership and support, the exchange program will be a great success.

Our school will be celebrating its ninetieth anniversary on the morning of May 6. We cordially invite you to find the time in your busy schedule to attend the event. Please advise us of your expected time of arrival by fax or letter as soon as possible. We look forward to hearing from you and are eagerly expecting your visit.

Finally I wish you good health and happiness, as well as great success in the educational endeavours of your district.

Comparing the two translations, we can see that Babel Fish did not commit any major errors, though it used the word *expensive* twice, which might cause some confusion. *Expensive* is the mistranslation of the Chinese character *gui* (贵), which serves as a

respectful form of address and can either be translated into "honourable" or be omitted. There is perhaps only one piece of important information, i.e. the sender's request for the recipient's expected time of arrival, that the Babel Fish translation – "Does your when presence" – fails to convey clearly. On the whole, Babel Fish has again done a pretty good job for gist-getting purposes.

However, monolingual users of low-end and free MT systems should be aware that any inaccuracy or mistake in the output has the potential of causing serious misunderstanding of the source material. A so-called "90-percent accurate" translation is no guarantee of a 90-percent accurate understanding of the source text, when an inaccuracy might misrepresent the meaning of the entire message:

1. 七八岁的男孩

seventy-eight-year-old boy (Babel Fish)
seven- or eight-year-old boy (author)
2. 英国人懂得喝茶，至今还不过两三百年的历史。
The English understands drinks tea, until now also only 2300 history. (Babel Fish)
The British did not learn to drink tea until two or three hundred years ago. (author)

In the above two examples Babel Fish made the same type of error in translating Chinese numbers. It is easy to tell that something is wrong in the first instance, as "seventy-eight-year-old boy" does not make sense except perhaps in a humorous context. The error in the translation of the second sentence is a bit less obvious, even though well-informed readers are supposed to know that the English could not have been drinking tea for 2300 history, whatever that means.

他五八年参加工作。
His 58 years participation work. (Babel Fish)
He joined the workforce in [19]58. (author)

In this instance it is quite difficult to guess the meaning of the source text by reading the Babel Fish translation. Context might help, but not if translation of that context is equally mangled:

他三九年出生，五八年参加工作。
His 39 years birth, 58 years participation work. (Babel Fish)
He was born in [19]39 and joined the workforce in [19]58. (author)

As previously mentioned, MT users who have some control over the source text may have it produced in an "MT-friendly" style to help improve translation quality. For Chinese source text, this means, among other things, denoting the year by the full form

(一九三九 instead of 三九) and using optional auxiliary words such as *yu* (于) and *le* (了) to clarify the grammatical structure:

> 他出生于一九三九年，于一九五八年参加了工作。
> He was born in 1939, started the work in 1958. (Babel Fish)
> He was born in 1939 and joined the workforce in 1958. (author)

8. MT for Dissemination

Consideration about whether and how to use MT depends on a realistic assessment of its efficiency and cost-effectiveness. MT would be a viable choice if overall quality and speed can be achieved at lower cost than through the employment of human translators. To get MT output of publishable quality, one must have a large, constant flow of text in a sublanguage to justify long-term investment of money and resources for the purchase and customization of a high-end MT system. The MT system typically comes with a modestly equipped dictionary, and to make the system work one has to keep feeding it information, a process that may take one to three years (An approach to MT implementation, 2002). SYSTRAN, while claiming its technology will "extend the perception of MT as a tool for more than simple gisting", stresses the need for customization:

> The extensive list of linguistic resources available within the SYSTRAN product allows vast customization potential. Users can customize their SYSTRAN application according to their text quality and type, their computing environment, required languages, and numerous other variables. Customization is essential to producing high-quality machine translation results. Simply used out of the box, MT software tends to have limited success because its knowledge bases are not equipped with the terminology and information needed for the subject area. (Flanagan & McClure 2002)

Common wisdom thus dictates that high-end MT should be tackled only by large groups with large projects. It should also be noted that when people compare machine and human translation, the proficiency and skill of human translators are often taken for granted. In reality, incompetent human translators not only make errors no machine will ever commit, such as misspelling and inconsistent use of terminology, but may also translate "just like machines do", such as taking words out of context and thoughtlessly copying definitions found in the bilingual dictionary into the target text. If a company's modest translation budget can only pay for the service of amateur translators, it might consider using low-end or even free MT. In fact, the two compromises to fully automatic high-quality translation, human involvement and indicative quality, are not mutually exclusive. Some translation companies now offer human-assisted MT with a price range

in between professional human translation and fully automatic MT. A type of low-quality MT using rapid post-editing has also been operating with success in the European Commission. In such cases translators must get used to the new quality standards and go over the MT output quickly, ignoring nonessential errors.

9. MT and Human Translators

MT is still synonymous with low quality in many people's minds, and today's MT systems do need the help of translators to optimize their performance. However, if quality is measured against the specific purpose or function of a translation, MT will certainly play an increasingly important role in the broad context of global communication. MT not only offers a high-speed, low-cost alternative to human translation but is also tackling tasks the human translator will probably never be able or willing to deal with, such as real-time translation of Web pages, translation of information retrieved from databases, and even the production of draft versions for authors writing in a foreign language. In a demand-driven market there are both high-end MT systems customized for quality translation of domain-specific material and medium- or low-end PC-based or online programs for gist-getting purposes. SYSTRAN, for example, offers a wide range of language translation products and services from the webpage translator for Internet browsing (SYSTRAN 5.0 WebTranslator, $29), to a desktop document translator with five specialized dictionaries and a customizable multilingual user dictionary (SYSTRAN 5.0 Professional Premium, $760), to corporate solution packages that involve MT systems development and linguistic customization.[1]

To get the desired translation output, users must be aware of the various MT options and their relative speed, cost and quality. They must know when and how to use MT, and when to opt for human translation, disregarding the marketing hype of some MT vendors. A common misuse of MT is for the translation of marketing materials, or indeed any text meant for general public consumption, which can make or break a company's image for its international customers and partners. The Onionskin, a client education column in the *ATA Chronicle*, the journal of the American Translators Association, often features garbled translations produced by either amateur translators or translation software. A recent article cited "frog's legs jumped in the garlic" and "almost cheese-dish of mold in spice on bed of spinach" from www.chefsimon.com, a website dedicated to French cuisine, and blamed such misuse of MT partially on "software vendors who systematically hype their wares to a monolingual audience, falling back on the fine print only when caught out" (Durban 2003). The quoted French to English translation was produced by Reverso, the flagship product of Softissimo, a French company whose

[1] Information retrieved on July 25, 2004 from SYSTRAN's website (http://www.systransoft.com/index.html).

message to potential clients does sound a bit misleading. "Softissimo has a leading position in translation software," claims the company's website. "Softissimo's translation software looks to be near word perfect."[1]

In terms of output quality, professional human translation and MT do not mix, a point often ignored by people who use MT for the sake of expediency. There seem to be many instances in which a client messes up a professional translation by using free MT to deal with some last-minute changes in the source text. The author was once commissioned to translate an English website into Chinese. When reviewing the Chinese site a few days after delivering the translation, the author found some nonsensical expressions that had not been in the original translation. Apparently the client added those items to the English website after it was submitted for translation, and decided to use Babel Fish to handle them. The errors were all the more glaring because as part of a navigation bar they appeared on almost every webpage, and they certainly did not fit well with the rest of the Chinese text (Figure 3).

[1] Information retrieved on July 25, 2004 from http://www.softissimo.com/index-e.htm.

Figure 3. An Example of MT Misuse

Translation by client (MT)	The author's translation	English source text
票商店	票务	ticket shop
方向	行路指南	directions
小组销售	团体购票	group sales
互联网商店 (英语唯一)	网上商店 (英语)	Internet store (English only)
音乐厅在公平的公园	博览会公园音乐厅	Music Hall at Fair Park

Developers are always seeking to improve MT performance through the refinement of current design techniques and the exploration of new models. Since the lack of translation common sense partially accounts for the poor quality output of many MT models, it would be worthwhile to review how human translators do their job and attempt to build a similar mechanism in the MT program. Human translators do not translate by following a set of prescribed rules but rely on knowledge and skills learned through experience to solve problems. They do not have to acquire all the linguistic and real-world knowledge in order to start translating, but instead keep enhancing their knowledge and skills through translation practice. It would be advisable for MT designers to try to improve the program's learning capabilities. This may mean, among other things, an ongoing interaction between the MT system and the translator during the translation process whereby the translator can train the program not only by feeding information to the terminology database and translation memory, but also by adjusting the core rules used by the program for source text analysis and target text generation. Today this type of training is being carried out only by computer engineers and linguists when developing and upgrading a product for mass production or customizing a product for a large client. A milestone will be reached when translators can buy a well-developed but open-ended MT product and customize it for their own purposes.

Generally speaking, the more decision-making power the professional translator has in the use of translation technology, the more likely it is to achieve high quality in the final output. A more human-centered approach also means the development of programs that assist translators in their work, in the form of computer-assisted translation (CAT) tools.

CHAPTER FOUR: COMPUTER-ASSISTED TRANSLATION (CAT)

1. History of CAT

The appearance of mass market personal computers in the 1980s and the subsequent growth of the Internet have transformed the translation profession. Like many other professionals, translators have demonstrated considerable adaptability to new ways of working brought about by computer technology. They now use a wide range of general software programs including word processing, electronic mail and Internet browsing, spreadsheets, graphics, desktop publishing, databases, and financial management. Until the late 1980s, MT systems aiming to replace human translators by fully automating the translation process remained the focus of research and commercial interest (Hutchins 1997). In the meantime there was not much progress in the development of computer tools for the purpose of enhancing the productivity of professional translators, even as specialized software packages contributed to the vastly improved performance of some other professionals such as accountants and graphic designers.

Though long overshadowed by MT, the idea of developing computer-based translation tools for translators, known as machine-assisted translation (MAT) or computer-assisted translation (CAT), dates back to the early 1960s. The ALPAC report of 1966, while dealing a heavy blow to MT research in the United States, encouraged support for the development of computer-based tools for translators such as text-related glossaries and terminological databases including terms in their sentence contexts (Hutchins 1998). Since then many people have advocated an integral approach to computer application in translation that takes into account the expertise and indispensability of professional translators.

Among the proponents of translation tools, Alan Melby was probably the first to use the term "translator's workstation" to describe a system of computer assistance for translators. In his view, human translators must have control over the system and decide whether to enlist the assistance of the computer on various occasions. Full automation would be counterproductive if it takes the translator more effort to edit the poor MT output than to start from scratch. He called for the "smooth integration of human and machine translations" at three levels of assistance: the first level would include word processing, telecommunications and terminology management tools, the second level would include access to translation memory, and the third level would involve a "full-blown MT system". Melby also stressed the importance of user friendliness of computer programs to ensure improved efficiency and productivity of the translation process, a factor sometimes overlooked by tool developers (Melby 1992).

Proponents of translation tools argue that humans and computers have different, often complementary roles to play in translation, and that the success of any translation system relies on human-computer cooperation. In his seminal work "The Proper Place of Men and Machines in Language Translation", Martin Kay wrote:

> Translation is a fine and exacting art, but there is much about it that is mechanical and routine and, if this were given over to a machine, the productivity of the translator would not only be magnified but his work would become more rewarding, more exciting, more human. (Kay 1980, 3)

According to Kay, history has no better example of the improper use of computers than MT. Researchers made a huge mistake by attempting to "mechanize the non-mechanical or something whose mechanistic substructure science has not yet revealed" (Kay 1980, 7). Instead of devoting all research resources to a distant ideal, namely fully automated high-quality MT, Kay proposed an incremental approach in the form of what he called the "translator's amanuensis" (Kay 1980, 13). Based on a multilingual text editor with a split screen, it would be augmented gradually with translation-related functions, including automatic dictionary look-up, access to previous translations to ensure consistency, and the optional use of MT, with the translator either letting the machine translate without intervention and post-editing the result, or assisting the machine to resolve ambiguities in an interactive process.

Despite the early recognition of the importance and desirability of computer-based tools for translators, the shift of research and commercial interest from fully automated MT to translation tools did not occur until the appearance of mass market personal computers in the late 1980s. It also coincided with a period of massive corporate downsizing in many parts of the world, when large companies dissolved their translation departments and outsourced translation services, forcing many in-house translators to go freelance (Canadian Translation Industry Sectoral Committee 1999). Tool producers who used to serve corporate clients (translation companies and large organizations with in-house translation departments) began to develop and market tools for use by individual translators. As envisaged by Kay and Melby, these tools typically offer, in addition to multilingual word processing, access to dictionaries and terminological banks (terminology management) and the storage and retrieval of previous translations (translation memory), though the integration of interactive MT has yet to become a common feature.

2. Translators and General-Purpose Computer Technology

In discussing computer-based tools for translators, we tend to take word processing software for granted because it is so commonplace, yet it has fundamentally changed the

way translators work and improved their productivity. The replacement of the typewriter by the word processor has also brought a subtle yet significant change in translators' work habits. Many translators used to think at the sentence level, working out the entire sentence or at least its overall structure in the mind before committing thought to paper, because it would be inconvenient and messy to make changes other than correcting simple typos. Word processing gives translators the freedom to work at the sub-sentence level, so that they can start at whatever word or phrase that comes to mind and build the sentence from there. This is an instance in which technology has affected the mental process of the translator, possibly for the better. Word processing cannot turn a bad translator into a good one, but it may help a good translator think more dynamically and possibly produce translation of a higher quality.

The continuous improvement of linguistically sophisticated functions in word processing packages such as spellchecker and thesaurus (and to a less extent, grammar and style checkers) will simplify the translation routine and provide faster access to information resources. However, as previously discussed, easy access does not always bring high quality. It is still up to the translator to choose the right word from the list of synonyms provided by the program's thesaurus, or to proofread the target text for correctly spelled but wrongly used words. On the other hand, word processing functions, by virtue of their consistence and thoroughness, can sometimes help translators maintain better quality control. For example, translators often decide on the "standard" translation of a word or phrase after encountering it several times, so a grammatically sensitive search and replace function can be quite useful. If the translator, when reviewing the translation, wants to change "buy" to "purchase", it would be nice to do a global search and replace so that "bought" is changed to "purchased", "buying" to "purchasing", "buyer" to "purchaser", etc. While such a one-touch global search and replace function is not yet available in current word processors, Microsoft Word does have the option "find all word forms", so that the translator can locate all the variants of "buy" with a single search and then choose the replacement word from a drop down list.

3. Translators and CAT

Traditionally, professional translators disliked the idea of MT and did not have a close relationship with MT developers, many of whom aimed at fully automatic systems capable of producing high-quality translation and considered human intervention as an interim arrangement. The existence of MT systems and the exaggerated claims made by some vendors also helped perpetuate the myth of translation being a simple, mechanical task requiring no special training or professional expertise. This further antagonized many translators, who felt the constant need to promote their profession and educate their clients about the complexity of the translation task. CAT tools, on the other hand, have been received favourably among professional translators because they (at least

theoretically) put the translator in control of the translation process and have the potential of enhancing productivity without compromising quality.

In contrast to the neglect of the expertise of professional translators by early designers of MT systems, CAT developers have a close working relationship with translators. Many are global providers of multilingual solutions offering both translation support software and translation and localization services. For example, Star Group, developer of a successful translation support package Star Transit, is also a translation service provider with worldwide presence. SDL International, a leading localization[1] company, has developed a series of translation tools including SDLX Translation Suite aimed at professional translators. Trados, whose Translator's Workbench has become a quasi-standard for the translation industry, is among a few major translation tool producers not offering translation service, but it operates translationzone.com, a website that provides freelance translators with product information, technical support, and a free translation service directory. Some translators have been directly involved in developing computer-based translation tools. In 1999 a freelance translator named Yves Champollion wrote a translation memory program, Wordfast, because he thought the products available were not only difficult to use but also too expensive. Offered for free at first, Wordfast became very popular among translators and began charging licensing fees in late 2002.

Since their appearance on the mass market in the 1990s, CAT tools have gradually and slowly gained a foothold in the translation community, though they still have a fairly low uptake compared with other types of computer programs. A recent survey of a group of freelance translators in the UK indicates that professional translators who are otherwise comfortable with computer technology have been slow in adopting translation tools. Of the 65 respondents, only 3% claimed to be using terminology management software of some kind, and only 8% reported using translation memory, though 97% said they work with PC and word processing packages (Fulford 2001). The 11 issues of *The ATA Chronicle* published by the American Translators Association (ATA) in 2002 contain only one article (Hunt 2002) on the topic. A search in ATA's translator directory also reveals the relatively low profile of translation tools among experienced translation professionals. Of the 29 ATA members accredited from English to Chinese, only six (or 20%) mention the use of translation support software.[2]

---

[1] Definition provided by LISA, Localization Industry Standards Association: "Localization involves taking a product and making it linguistically and culturally appropriate to the target locale (country/region and language) where it will be used and sold." Retrieved July 31, 2004 from http://www.lisa.org/info/faqs.html.

[2] Information retrieved April 25, 2004 from ATA's Online Directory of Translation and Interpreting Services at http://www.americantranslators.org/tsd_listings/.

The price of desktop packages of translation tools has steadily gone down over the years to well within the reach of individual translators[1], so why do the majority of translators prefer to work with word processors alone rather than pick up the latest CAT tools that claim to give them improved quality and productivity as well as work satisfaction? For one thing, CAT users face obstacles not present in word processing programs. Lack of user friendliness is a common problem, with most products requiring a steep learning curve even for translators highly proficient with word processors. The initial investment of time and resources in order to make the tools work can be prohibitive. Like MT systems, CAT tools are never plug-and-play. In the Fulford survey a number of translators who had purchased translation tools had yet to start using them because they claimed to lack the time to create their terminology database or translation memory from previous translations and terminology collections.

Whether the adoption of translation tools can improve productivity over the long run depends largely on individual translators – their professional skill, computer proficiency and area of specialization. Translation has remained a craft in which language skills and subject area expertise largely determine the quality of work. Just as MT systems require a substantial amount of inputting and tuning by language experts in order to produce output of reasonable quality, CAT tools can only help skilled translators who are committed to the integration of such tools into their everyday work. The effectiveness of CAT tools also depends on the nature of documents to be translated. For software localization, a translator may find CAT use mandatory because of the need to handle the various tags surrounding the user interface text, the often repetitive content of the documents (e.g. the updated version of a user's guide that goes with a new release of the software), and the pressure of producing high-quality, consistent results on a tight schedule. At the other end of the spectrum, a literary translator can probably afford to ignore CAT for the time being, though it might still be helpful to be able to use digital resources such as corpora and online dictionaries. Most professional translators fall somewhere in between, dealing with a few specialized areas as well as general texts. For them, whether to use translation tools is determined by various factors such as their comfort level with new computer programs and their perception as to whether a particular package offers enough useful features to justify the investment of time and money.

4. Terminology Management

An examination of the two main components of CAT packages, terminology management and translation memory, points to various factors, ranging from user-friendly design to

---

[1] Listed prices on developers' websites on April 10, 2004: Wordfast, €180 (http://www.wordfast.net/); Trados 6.5 Freelance, €695 (http://www.translationzone.com/catalog.asp); Déjà Vu X Professional, €990 (http://www.atril.com/); SDLX Professional Edition, US $1195 (http://www.sdlintl.com/).

equitable pricing scheme for translation services, that may contribute to the effective use of CAT tools by translators and translation companies. Terminology management serves to identify, extract, store, re-order, use and update significant terms with their translations in various languages. Stored terminology may include whatever fields the user deems necessary, such as definitions, subject area, examples of usage, multiple translations, and cross-references to other terms. The primary function is to access specialized terms in the source language with standard "equivalents" in the target language. The value of terminology management offered by translation tools does not seem to be a subject of debate. Searching for translations of specialized terms is a major part of most translation projects. Experienced translators who do not have to struggle with grammar or style must consult dictionaries, glossaries and other terminological resources to ensure the correct translation of terms they are unfamiliar with. They may have to create terminology lists for specific customers to ensure consistent usage. Terminology management involves a lot of work that is non-creative or "mechanical" in nature and as such lends itself well to computer automation.

Online access to multilingual term banks managed by expert groups such as Termium[1] in Canada has long been a useful resource for translators. However, to improve efficiency, electronic terminology databases should be fully integrated with the word processing function, an issue tackled by tool developers with partial success. Most translation tool packages give the translator access to terminology management from the translation screen, highlighting the terms available in the selected term bank and allowing the translator to either reject the translation or paste it with a mouse click. However, the tool package arrives with empty term banks, and the translator has to build them from scratch. The initial build-up and ongoing updating and maintenance set high demands on the user with regard to obtaining the data and inputting and maintaining them in the program. One must identify and extract relevant terms from the source text, find the corresponding terms in the target language from a translated text or other sources, conduct research to verify the correctness of term pairs, and enter the terms into the database. Most terminology management tools, such as Trados MultiTerm, a component of the Trados Freelance package, differ significantly in user interface from general-purpose word processing software and require many hours of learning. The option to create a term bank in MS Word and import it into MultiTerm is also time-consuming due to the various tags needed to delimit the fields of each entry.

One way to facilitate terminology acquisition might be for tool developers to offer ready-made but customizable term banks as a starting point for translators and simplify the process of term extraction from existing translations. However, commercial term bank

---

[1] Termium® is a Government of Canada linguistic data bank containing descriptions for over 3.5 million terms in English and French. Annual subscription is Cdn $225. A CD-ROM version is also available. Information retrieved on July 31, 2004 from http://www.termiumplus.translationbureau.gc.ca/site/accueil_home_e.html.

publishing catering for terminology management tool users may have to wait until the number of corporate and individual users of any particular terminology management product makes it economically viable. In the meantime translators have to use terminology sources external to their translation tools or create their own term banks from scratch as needed. There has been research into bilingual terminology acquisition from existing translations by means of interactive human-computer cooperation (Dagan & Church 1997), but the seamless integration of terminological resources into the translator's workflow may have to await not only better software design but also the attainment of an economy of scale for CAT tools.

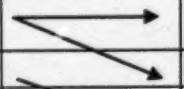
5. Translation Memory

Apart from terminology banks, one of the best resources for translators is past translations. If a previous translation offers an appropriate way to translate a word, phrase or expression in context, the translator should have the option to reuse that translation, partially or completely, rather than translate from scratch. Translation memory (TM), perhaps the single most important feature of CAT tools, allows the storage and re-use of matched pairs of source and target texts. The TM program can compare the new text with the database and retrieve identical segments for use in the new translation. Like terminology management, TM does not arrive with ready-made content. It is the job of the translator to set up and populate the TM databases. In addition, TM does not become useful until the translator comes across something very similar to a previously translated text. This requires significant initial investment of time and resources, unless the translator happens to be working on a text of a repetitive nature, in which case the TM tool will alert the user of the previous translation, which the user can choose to accept or reject:

> **From Carrollton:**
> Take I-35 South. Follow signs to I-30 East. *Exit Second Avenue (the first exit to your right). As you come down the exit ramp, the Music Hall is directly in front of you. To park on the Fair Grounds, bear right as you come down the exit ramp to the light at Grand Avenue and turn left.*
> **From DFW Airport:**
> Exit the airport using the North exit. Take Hwy 114 heading to Dallas. Hwy 114 will merge into Hwy 183 at Texas Stadium. Hwy 183 will merge into I-35 South. Follow signs to I-30 East. *Exit Second Avenue (the first exit to your right). As you come down the exit ramp, the Music Hall is directly in front of you. To park on the Fair Grounds, bear right as you come down the exit ramp to the light at Grand Avenue and turn left.*

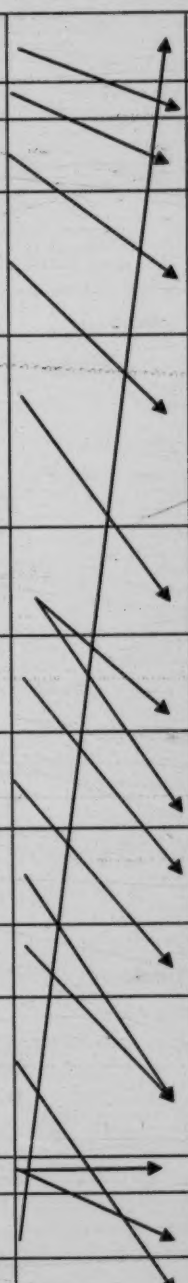
TM is easier to build than term banks using existing translations, thanks to the availability of the bilingual alignment function in most tool packages, such as WinAlign in Trados, which can process legacy documents by matching source segments with their translations. However, like term extraction, this process is not fully automatic and requires the translator to play an interactive role to optimize the result. A common problem is that a sentence in the source text may not correspond neatly to a sentence in the translation. This is especially true for languages not closely related such as English and Chinese, for which punctuation conventions and the concept of the sentence differ significantly. The short Chinese letter and its English translation quoted in a previous example take only a few seconds for Trados WinAlign to come up with its suggested alignment scheme, which then has to be manually adjusted by the translator (Figures 4 & 5). The translated text follows the English convention of putting date at the beginning rather than the end of the correspondence, which resulted in a major alignment error by WinAlign. A few more errors could be attributed to the rearrangement of sentences during translation. A translator habitually working with such a TM program may have to decide whether to translate in a more "TM-friendly" way in order to save time on TM build-up and maintenance. That would mean following the sentence arrangement in the source text as much as possible, which sometimes would violate target language convention and therefore compromise translation quality.

Figure 4. Chinese-English alignment suggested by Trados WinAlign[1]

尊敬的学监 XXX 女士：		XXXX, 20XX
您好！		Dear Madame Superintendent XXX:
我多次给您发传真，不知收到否？		How are you?
依据去年底我校与贵区独立中学高中校友好交流协议，今年将抓紧时间双方互派学生进行短期交流。		I have sent you faxes several times and I wonder if you have received them.
我们相信这项交流活动在您的指导与支持下一定会成功圆满！		By the exchange agreement signed between our school and the senior high section of your independent school district, both sides will be sending short-term exchange students this year.
5 月 6 日上午，我校将举行九十华诞庆典，敬请您在百忙之中光临。		We believe that with your leadership and support, the exchange program will be a great success.
您何时光临请尽快给我们发传真或发信来。		Our school will be celebrating its ninetieth anniversary on the morning of May 6.
我们热切地盼望和期待您的到来，静候您的回音。		We cordially invite you to find the time in your busy schedule to attend the event.
最后，衷心地祝愿您身体健康，生活愉快。		Please advise us of the time of your arrival by fax or letter as soon as possible.
祝愿贵区教育教学事业发达！		We look forward to hearing from you and are eagerly expecting your visit.
XX 中学		Finally I wish you good health and happiness, as well as great success in the educational endeavours of your district.
校长：XXX		XXX
20XX 年 X 月 X 日		Principal
		XXX Middle School

[1] Alignment performed by WinAlign of Trados Freelance 5.5.

Figure 5. Chinese-English alignment finalized by the author.

尊敬的学监 XXX 女士：		XXXX, 20XX
您好！		Dear Madame Superintendent XXX:
我多次给您发传真，不知收到否？		How are you?
依据去年底我校与贵区独立中学高中校友好交流协议，今年将抓紧时间双方互派学生进行短期交流。		I have sent you faxes several times and I wonder if you have received them.
我们相信这项交流活动在您的指导与支持下一定会成功圆满！		By the exchange agreement signed between our school and the senior high section of your independent school district, both sides will be sending short-term exchange students this year.
5 月 6 日上午，我校将举行九十华诞庆典，敬请您在百忙之中光临。		We believe that with your leadership and support, the exchange program will be a great success.
您何时光临请尽快给我们发传真或发信来。		Our school will be celebrating its ninetieth anniversary on the morning of May 6.
我们热切地盼望和期待您的到来，静候您的回音。		We cordially invite you to find the time in your busy schedule to attend the event.
最后，衷心地祝愿您身体健康，生活愉快。		Please advise us of the time of your arrival by fax or letter as soon as possible.
祝愿贵区教育教学事业发达！		We look forward to hearing from you and are eagerly expecting your visit.
XX 中学		Finally I wish you good health and happiness, as well as great success in the educational endeavours of your district.
校长：XXX		XXX
20XX 年 X 月 X 日		Principal
		XXX Middle School

Though translators recognize the usefulness of existing translations to new translation tasks, there is no guarantee that TM will always improve translator

performance. Tool vendors claim that TM greatly improves the efficiency of translators, who will never have to translate the same text twice, and helps maintain consistency in writing style. In other words, TM will both increase speed and improve quality. However, with few exceptions such as table cell entries and list elements, TM aligns bilingual or multilingual text at the sentence level. By their very nature sentences are unique and infinite in number. The argument that the sentences one translates today might become useful in the future applies only to partially repetitive texts such as updated or revised documents, which make up only a small part of translation work. In the previous alignment example, it is hard to tell whether the TM containing the Chinese letter and its translation will ever become useful enough to justify the minimum of several minutes spent on creating it.

For translators who do not specialize in highly repetitive texts, most TM tools offer the so-called fuzzy matching feature that lets the user set a similarity threshold, or the acceptable degree of fuzziness, in the form of a percentage. The program will present one or more close matches along with fuzzy match scores. A higher match score, however, does not always indicate a higher usability. Matching is essentially based on character-string similarity, or a simple calculation of the number of different characters in two sentences, much to the neglect of semantic considerations. In the following two examples, Translator's Workbench, the TM program from Trados, assigns (a) a higher fuzzy match score than (b) even though in both cases the translator would find the translated text (b) to be more useful:[1]

1. The child is mending his toy.
孩子在修理他的玩具。
(a) The chief is mending his tool. (match score: 72%)
头领在修理他的工具。
(b) The children are mending their toys. (match score: 62%)
孩子们在修理他们的玩具。

2. Select "Symbol" in the Insert menu.
在插入菜单中选择"符号"。
(a) Select "Paste" in the Edit menu. (match score: 78%)
在编辑菜单中选择"粘贴"。
(b) Select "Symbol" in the Insert menu to enter a character from the symbol set. (match score: 49%)
在插入菜单中选择"符号"，键入符号集中的某个字。

[1] Fuzzy matching scores obtained by using the default settings of Translator's Workbench in Trados 5.5 Freelance.

Obviously, it would be useful to develop more sophisticated matching methods that incorporate linguistic knowledge of synonyms, inflections, and grammatical alternations to award a higher matching score to structurally dissimilar but semantically comparable sentences.

TM will certainly appeal to more translators if it can efficiently match sub-sentence units in continuous texts. One proposed solution is to index every word in context, allowing the user to search for previously translated text at the word and phrase level (Hunt 2003). However, to trace a word or phrase from the source text to the target text demands a great deal of human intervention, and the final result has to prove very beneficial to justify the cost. Again, with languages that are not closely related, such as English and Chinese, the process may not work well due to the often drastic structural reorganization during translation. CAT developers should adopt the incremental approach advocated by Kay over 20 years ago. When tackling a problem as complicated as language translation, they must strike a proper balance between the roles of man and machine in order to achieve optimum efficiency, rather than search for a distant, perhaps impossible, purely computer-based solution.

A sensitive issue relating to TM that may affect translation quality is how much customers should pay for translations done with a TM package, which the translator has to purchase, set up and learn to use. Even for 100% matches the translator still has to check if the translation offered is of acceptable quality and make sure it fits in well with the rest of the translated text. However, if the client offers to pay nothing for 100% matches, the translator may be reluctant to spend time checking them. While adapting partial matches may take less time than translating from scratch, the amount of work is not proportional to the fuzzy match score. In fact, there is evidence that TM's usefulness "diminishes rapidly" when the fuzzy match score is below 75% and the number of matches over half a dozen (Somers 2003).

Unlike MT output, the content of TM is created by human translators and usually of reasonable quality, but the use of TM for any particular project should not be a matter of course. Translators sometimes complain of being given "bad" TM to work with. The translator may have the choice of rejecting a previous translation due to its low quality or stylistic incompatibility, but is unlikely to do so if the client pays reduced rates for texts that reach a certain fuzzy match score in the provided TM. In such cases, poor quality may result from the use of translation technology because of bad decision-making on the part of the project manager or the client. As previously discussed, clients who commission the translation have great power, but they are not always in a position to judge the quality of a resource. Many translation tasks today require the use of project-specific references such as client-approved term lists or a previous version of the same document, but the translator should have a say in whether and how such references can best be used. By making it easier for clients or project managers to impose their judgment about translation-related resources on the translator, translation technology such as TM has the potential to impair translation quality.

6. The Future of CAT

To fulfill their promise of improving productivity and maintaining quality, CAT tools have to gain the full acceptance of translators. Large translation companies and translation departments of international organizations have been the main driving force behind the development and use of CAT tools, a role not always appreciated by individual translators. These organizations are more willing to invest in translation technology because they need translation management software for large projects that require the coordination of many translators, and they can afford to invest time and money in data transfer from legacy systems. Some professional translators feel that clients (typically translation companies rather than direct clients) are pressurizing them into using CAT, especially TM, because these companies stand to get the most benefit from the use of TM by offering lower rates for previously translated texts and demanding tighter deadlines for delivery. The pressure to adopt CAT tools has upset some translators, who question their cost-effectiveness as well as productivity. The pricing schemes involving the use of TM often cause contention between translators and their clients. As a Canadian translator points out, a client would typically expect 80% in savings for the translation of an updated version of a user's manual when the company's TM software recognizes 80% of the text. However, the translator still needs to review the recognized segments to see if they fit the new context or if they need improvement, and may have to convert files between different translation software packages, so that the total savings in time may end up being much less than 80% (Translator X 2003). Therefore the savings brought about by CAT should not be exaggerated, and they should not come at the expense of individual translators, who play a pivotal role in translation quality control.

Despite their limitations, CAT tools have a bright future. Some barriers to tool adoption among translators, such as those related to data transfer and the leverage of legacy translation, are expected to vanish over time. Greater computing power and better software design based on a good understanding of translators' needs will result in better tools, including eventually the integration of interactive MT. More significantly, economic globalization has brought about a heightened awareness of the indispensable expertise of translators. As people increasingly realize that translation is not an expense that should be kept as low as possible but an essential part of product development, more efforts will be devoted to improving the productivity and job satisfaction of translators. Even the wide availability of MT systems may work in the translator's favour in the long run, as people using crude MT output will learn to appreciate the added value of professional translations and the need to provide translators with better technological support. Like many other professionals, translators will have better, more powerful computer-based tools that improve both the quality and productivity of their work.

CONCLUSION

The above discussion on translation quality and the two major categories of translation technology, MT and CAT, has brought out several salient points on the relationship between translation quality and translation technology. Translation technology has redefined the concept of translation quality in terms of function or purpose. Translation technology cannot create high-quality translation without human intervention, nor can it improve the expertise of human translators, but it can assist human translators by offering easy access to more translation-related resources. Translation technology may also help ensure quality by facilitating translation project management, provided that decision-making power resides with those with the translation know-how to use it wisely.

Translation technology, especially the widespread use of MT, has influenced the concept of translation quality. The functionalist approach to translation quality control makes perfect sense in the age of Internet and economic globalization. Quality no longer has to be good; it only has to be good enough. In other words, the quality of a translation should be acceptable if it meets the requirements of the user. This complication of quality assessment standards makes it more important than ever before to clearly define the purpose of the translation and determine the user's requirements, such as whether the translation is for assimilation or dissemination. There is no point in saying MT is synonymous with poor quality, when many MT systems such as Babel Fish are designed for gist-getting purposes. On the other hand, MT developers should be more outspoken about the limitations of their products: Babel Fish's performance varies with different language pairs and different types of text, and it may fail completely to get the gist of a source text.

Translation technology cannot yet create high quality without human intervention. Unless we only need indicative quality, translation technology does not offer a turnkey solution. This is true of both MT and CAT. To achieve high quality, an MT system has to be customized and tuned for a particular text type or subject area, and staff must be trained to produce appropriate source texts, update the dictionaries, and edit the MT output. Current MT systems process words and phrases rather than sentences, with no understanding of the meaning of the entire source text. Therefore they cannot produce quality translation of general texts in which the meaning of words depends on the larger context. CAT tools are basically digital versions of paper-based resources for translators, such as terminology lists and previous translations. The fact that such resources are digitized and incorporated into the translator's computer workspace by no means guarantees their quality. Quality in translation still relies on knowledge workers, including translators, terminologists, writers, editors and subject area experts as well as computer programmers and engineers. Since translation technology does not have a direct bearing on the professional expertise of these knowledge workers, it is not yet a major

factor in determining translation quality. In some cases, translation technology may have no correlation with translation quality at all. Translation companies may attempt to assure customers of the quality of their service by either denigrating translation technology (e.g. claiming to use 100% human translation) or commending it (e.g. boasting the adoption of the state-of-the-art CAT package), but in either case translation technology (or the lack of it) would have much less impact on the quality of their service than the qualifications of their project managers and in-house and freelance translators.

Though it cannot create high quality, translation technology can serve as a useful tool for translators by offering them better access to more resources, which is another major factor in determining translation quality. It still takes a team of terminologists to create a good term bank, but a terminology management system will make it easy for translators assigned to the same project to share the same terminology list and ensure that standard translations from the list are consistently used in the target text. People who have a terminology management system incorporated into their translation workspace do not necessarily have high quality terminology data, but they may be able to use the data more efficiently than those who rely on traditional paper-based or stand-alone resources. The same is true for TM: high quality aligned texts, once created by translators and entered into the system, can not only save time but also improve quality by adding a level of consistency, and may even serve as a learning tool for novice translators.

In the final analysis, translation quality relies on good project management - the effective use of people and resources. To achieve high quality, the authority to make key management decisions should reside with those who know best how to use it. In terms of its effect on translation project management, translation technology is the proverbial double-edged sword, with the potential of being abused and causing harm. Thanks to its growing functionality, it has power to propagate good or bad quality - to magnify the effect of a good or bad decision tenfold. Previously, an overly budget-conscious client who offered low rates to translators for projects requiring professional quality might, with a bit of luck, get professional quality translations from time to time. Nowadays, the same client would just as likely decide to use cheap or even free MT, whose output is inevitably of indicative quality. A case like that does not represent the failure of MT but rather the misuse of MT due to human errors. Likewise, CAT tools can be used to leverage human expertise or magnify human incompetence. A bad decision at the management level, such as adopting an outdated terminology bank or a low-quality TM, offering low rates for TM matches (thus discouraging translators from making possible improvement to the existing TM), or assigning the authority to update the terminology bank or TM to people not professionally qualified to do so, will do great damage by spreading and perpetuating low-quality data throughout the translated text. To make the best use of translation technology and achieve optimum translation quality, therefore, it is more important then ever before to assign the decision-making power to people who understand the translation process and who can make the right choices with regard to translation quality control. While fully automatic high-quality translation remains a

distant goal, today and in the near future the role of translation technology is to help humans make better decisions faster by giving them ready access to each other's expertise and to various information resources in an increasingly user-friendly manner.

This thesis has addressed the complex topic of the relationship between translation technology and translation quality mainly from a professional translator's perspective. The issues treated in this thesis can be further scrutinized in a number of ways. Most MT examples cited in the thesis demonstrate the performance of a popular free online MT system, Babel Fish. The use of primary data from some "high-end", customizable MT system would have shed more light on both the limitations and potentials of MT. A more detailed analysis of the unique features of the Chinese language (such as the absence of verb tense) may also serve to highlight the complexity of the problems MT systems have to resolve in order to achieve acceptable output quality. The thesis has discussed the three traditional MT approaches and identified their fundamental weaknesses, such as the lack of context analysis beyond the sentence level. It would be fruitful to examine some of the alternative approaches such as knowledge-based MT and statistics-based MT to find out whether they may eventually succeed in solving or circumventing some of the problems inherent in the traditional MT models. Since all current MT systems lack understanding and learning capabilities, an examination of artificial intelligence and its possible application to language processing will result in a clearer picture of the future of translation technology. With regard to CAT, the thesis mainly focuses on stand-alone packages used by professional translators, such as Trados Freelance. The argument about the leverage of CAT tools may be strengthened by looking at translation management software used by large translation companies and multinational corporations to coordinate projects involving multiple languages and multiple translators in various locations. In a word, the dynamic relationship between translation technology and translation quality can be appreciated only through a comprehensive assessment of the various aspects of translation and the latest developments in translation technology as well as the evolving needs for translation services in a constantly changing world.

BIBLIOGRAPHY

Abaitua, J. (1999). Is it worth learning translation technology? Retrieved Feb 15, 2003, from http://sirio.deusto.es/abaitua/konzeptu/ta/vic.htm

Arnold, D., Balken. L., Meijer, S., Humphreys, R. L. & Sadler, L. (1994). *Machine Translation: An Introductory Guide*. London: NCC Blackwell.

Austermuhl, F. (2001). *Electronic Tools for Translators*. Manchester: St. Jerome Publishing.

Baker, M. (1992). *In Other Words. A Coursebook on Translation.* London: Routledge.

Bell, R. T. (1991). *Translation and Translating: Theory and Practice*. London: Longman.

Bernth, A. (1998). EasyEnglish: Addressing Structural Ambiguity. In D. Farwell, L. Gerber & E. Hovy (Eds.), *Machine Translation and the Information Soup* (pp. 164-173). Heidelberg: Springer.

Budiansky, S. (1998). Lost in Translation. *The Atlantic Monthly, Volume 282, No. 6,* 80-84.

The Canadian Oxford Dictionary. (2001). Oxford: Oxford University Press.

Canadian Translation Industry Sectoral Committee. (1999). *Survey of the Canadian Translation Industry*. Retrieved April 1, 2003, from http://www.uottawa.ca/associations/csict/princi-e.htm

Champollion, Y. (2001). Machine translation (MT), and the future of the translation industry, *Translation Journal, 5*(1). Retrieved 18 Oct 2002, from http://accurapid.com/journal/15mt.htm

Chan, S. (Ed.). (2003). *Translation and Information Technology*. New York: Columbia University Press.

Chandioux, John. (2003). Translation Technology for Sale: Buyer Beware! *The LISA Newsletter*. Vol. XII, No. 3.1. Retrieved Sep 20, 2004, from http://www.lisa.org/archive_domain/newsletters/2003/3.1/chandioux.html

Chen, Z. (2004). Translation: the betrayal of betrayal. Retrieved Aug 7, 2004 from http://www.china-translate.net/productShow.asp?id=194

Clements, W. (2000, August 24). Wordplay: innocent words, sullied in translation. *Globe and Mail*.

Cole, R. A., Mariani, J., Uszkoreit, H., Zaenen, A., & Zue, V. (Eds.). (1996). Survey of the State of the Art in Human Language Technology. Retrieved April 20, 2003, from http://cslu.cse.ogi.edu/HLTsurvey/HLTsurvey.html

Cornish, E. (2001). Trend impact analysis: the arrival of automated translation technology. *Futurist, 35*, 21

Dagan, I. & Church, K. (1997). Termight: Coordinating Humans and Machines in Bilingual Terminology Acquisition. *Machine Translation, 12*, 89-107.

Denison, D.C. (2003). Guess Who's Smarter. *The Boston Globe*, May 26, 2003. Retrieved July 18, 2004 from http://web.media.mit.edu/~lieber/Press/Globe-Common-Sense.html

Durban, C. (2003). The Onionskin. *The ATA Chronicle, 32(7)*, 45-46.

Fenner, A. (2000). The Choices Facing Translators. *Institute of Translation and Interpreting Bulletin*, April 2000, 9.

Flanagan, M. & McClure, S. (2002). SYSTRAN and the Reinvention of MT. Retrieved June 23, 2004 from http://www.systransoft.com/IDC/26459.html

Fulford, H. (2001). Translation Tools: An Exploratory Study of Their Adoption by UK Freelance Translators. *Machine Translation, 16*, 219-232.

Gentzler, E. (1993). *Contemporary Translation Theories*. New York: Routledge.

Gross, A. (1991). Where do Translators Fit into Machine Translation? Retrieved April 20, 2003, from http://www.foreignword.com/Technology/art/Gross/gross91.htm

Halliday, M. A. K. (1989). *Spoken and Written Language.* Oxford: Oxford University Press.

Hatim, B., & Mason, I. (1997). *The Translator as Communicator.* London: Routledge.

Hickey, L. (Ed.). (1998). *The Pragmatics of Translation.* Clevedon: Multilingual Matters.

House, J. (2001). Translation Quality Assessment: Linguistic Description versus Social Evaluation. *Meta*, XLVI, 2, 2001. Retrieved April 21, 2003, from http://www.erudit.org/revue/meta/2001/v46/n2/003141ar.pdf

Hunt, T. (2002). Translation Support Software: The Next Generation Replacement to CAT Tools. *The ATA Chronicle, 31(1),* 49-53.

Hunt, T. (2003). Translation Technology Failures and Future. *The LISA Newsletter*, December 31, 2002. Retrieved Feb 22, 2003, from http://www.lisa.org/archive_domain/newsletters/2002/4.6/hunt.html

Hutchins, J. (1986). *Machine Translation: past, present, future.* West Sussex: Ellis Horwood.

Hutchins, J. (1994). The Georgetown-IBM demonstration, 7th January 1954. *MT News International* 8, May 1994, 15-18. Retrieved Sep 20, 2004 from http://ourworld.compuserve.com/homepages/WJHutchins/GU-IBM.htm

Hutchins, J. (1997). Translation Technology and the Translator. Retrieved Feb 15, 2003, from http://ourworld.compuserve.com/homepages/wjhutchins/ITI-97.htm

Hutchins, J. (1998). The Origins of the Translator's Workstation, *Machine Translation, 13*, 287-307.

Hutchins, J. (1999). The development and use of machine translation systems and computer-based translation tools. Retrieved Oct 18, 2002, from http://www.foreignword.com/Technology/art/Hutchins/ hutchins99_1.htm

Hutchins, J. (2002). The State of Machine Translation in Europe and Future Prospects. Retrieved Oct 18, 2002, from http://www.hltcentral.org/htmlengine.shtml?id=917

Hutchins, J. (2003) Machine translation and computer-based translation tools: what's available and how it's used. Retrieved June 6, 2004 from http://ourworld.compuserve.com/homepages/WJHutchins/Valladolid-2003.pdf

Hutchins, J. & Hartmann, W. (2002). *Compendium of Translation Software*. The European Association for Machine Translation. Retrieved October 26, 2002, from www.eamt.org

Hutchins, J. & Somers, H.L. (1992). *An Introduction to Machine Translation*. London: Academic Press.

Jang, H. (2000). Translation quality and the reader's response. Retrieved Dec 15, 2003 from http://www.ntu.edu.au/education/csle/student/jang/jang1.html

Jurafsky, D. & Martin, J. H. (2000). *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. Upper Saddle River, NJ: Prentice Hall.

Kay, M. (1997). The Proper Place of Men and Machines in Language Translation, *Machine Translation, 12*, 3–23.

King, G. W. (1956). Stochastic Methods of Mechanical Translation. In Nirenburg, S., Somers, H. & Wilks, Y. (Eds.) (2003), *Readings in Machine Translation* (pp. 37-38). Cambridge, Massachusetts: The MIT Press.

Kulagina, O. S. & Mel'cuk, I.A. (1967). Automatic Translation: Some Theoretical Aspects and the Design of a Translation System. In Nirenburg, S., Somers, H. & Wilks, Y. (Eds.) (2003), *Readings in Machine Translation* (pp. 157-175). Cambridge, Massachusetts: The MIT Press.

Lange, C. A., & Bennett, W. S. (2000). Combining Machine Translation with Translation Memory at Baan. In R. C. Sprung (Ed.), *Translating into Success: Cutting-edge Strategies for Going Multilingual in a Global Age* (pp. 203-218). Amsterdam: John Benjamins.

Lange, J., Gaussier, E. & Daille, B. (1997). Bricks and Skeletons: Some Ideas for the Near Future of MAHT. *Machine Translation, 12*, 39–51

Li, D. (2002). Teaching Information Technology in Translator-Training Programs in Hong Kong. *The ATA Chronicle, 31*(3), 29-33

McClure, S. & Flanagan, M. (2003). Overcoming the MT Quality Impasse. Retrieved April 21, 2004 from http://www.systrangroup.net/IDC/29917.htm

Melby, A. (1992). The translator workstation. In J. Newton (Ed.), *Computers in translation: A practical appraisal* (pp. 147-165). New York: Routledge.

Melby, A. (1995). *The Possibility of Language: A Discussion of the Nature of Language, With Implications for Human and Machine Translation*. Amsterdam: Benjamins.

Melby, A. (1995). Why Can't a Computer Translate More Like a Person? Retrieved Dec 22, 2003 from http://www.ttt.org/theory/barker.html

Melby, A. (2001). Should I use machine translation? Retrieved April 20, 2003, from http://www.ttt.org/theory/mt4me/index.html

Mossop, B. (2001). *Revising and Editing for Translators*. Manchester: St. Jerome Publishing.

National Science Foundation. (1999). Multilingual Information Management: Current Levels and Future Abilities. Retrieved April 25, 2004 from http://www-2.cs.cmu.edu/~ref/mlim/index.shtml

Newmark, P. (1991). *About Translation*. Clevedon: Multilingual Matters.

Nirenburg, S. (2003). Bar Hillel and Machine Translation: Then and Now. Retrieved April 23, 2004 from http://ilit.umbc.edu/SergeiPub/bar-hillel.pdf

Nirenburg, S., Carbonell, J., Tomita, M. & Goodman, K. (1992). *Machine Translation: A Knowledge-Based Approach*. San Mateo, CA: Morgan Kaufmann Publishers.

Nirenburg, S., Somers, H. & Wilks, Y. (Eds.) (2003). *Readings in Machine Translation*. Cambridge, Massachusetts: The MIT Press.

Nogueira, D. (2002). Translation Tools Today: A Personal View. *Translation Journal*, Vol. 6, No. 1. January 2002. Retrieved April 20, 2003, from http://accurapid.com/journal/19tm.htm

Prior, M. (2003). Close Windows. Open Doors. *Translation Journal*, Vol. 7, No. 1. January 2003. Retrieved April 20, 2003, from http://accurapid.com/journal/23linux.htm

Ray, D. S., & Ray E. J. (1999). Good, Fast, Cheap: Translation Memory Systems Offer the Potential for All Three. *Technical Communication,* May 1999, Vol. 46, No. 2. Retrieved April 19, 2003, from http://www.techcomm-online.org/issues/v46n2/full/0327.html

Samuelsson-Brown, G. (1998). *A Practical Guide for Translators*. Clevedon: Multilingual Matters.

Schäffner, C. (Ed.) (1998). *Translation and Quality*. Clevedon: Multilingual Matters.

Schaffner, C. (Ed.) (2000). *Translation in the Global Village*. Clevedon: Multilingual Matters.

Shields, M. (1999). Slaves to the Computer, *Institute of Translation and Interpreting Bulletin*, October 1999, 4-5.

Silberman, S. (2000). Talking to Strangers. *Wired*, May 2000, Issue 8.05. Retrieved June 21, 2004 from http://www.wired.com/wired/archive/8.05/translation.html

Snell-Hornby, M. (1988). *Translation Studies. An Integrated Approach*. Amsterdam: Benjamins.

Somers, H. (1992). Current research in machine translation. In J. Newton (Ed.) , *Computers in translation: A practical appraisal* (pp. 189-207). New York: Routledge.

Somers, H. (Ed.) (2003). *Computers and Translation*. Amsterdam: Benjamins.

Sprung, R. C. & Jaroniec, S. (Eds.) (2000) *Translating into Success: Cutting-edge strategies for going multilingual in a global age*. Amsterdam: Benjamins.

Su, K. & Chang, J. (1999). A Customizable, Self-Learnable Parameterized MT System: The Next Generation. Retrieved July 29, 2004 from nlp.csie.ncnu.edu.tw/~shin/doc/summit/mt.summit7.v4.PDF

Sun, H. (1998). *Chinese-English Translation: A Skills Approach*. Beijing: Foreign Languages Press.

Tamaki, Y. (2003). Project using TRADOS 5.5 Freelance. Translation Journal, Volume 8, No. 1, January 2004. Retrieved Oct 22, 2003, from http://www.accurapid.com/journal/27trados.htm

Toury, G. (1995). *Descriptive Translation Studies and Beyond*. Amsterdam: Benjamins.

Translator X. (2003). Towards A More Equitable Pricing Structure: A Translator's Perspective. *The LISA Newsletter*. Vol. XII, No. 1.4. Retrieved Feb 25, 2003, from http://www.lisa.org/archive_domain/newsletters/2003/1.4/transX.html

Venuti, L. (Ed.) (2000). *The Translation Studies Reader*. New York: Routledge.

Walmer, D. (1999). One Company's Efforts to Improve Translation and Localization. *Technical Communication*, Second Quarter 1999, 230-237

Weaver, W. (1949). Translation. In Nirenburg, S., Somers, H. & Wilks, Y. (Eds.) (2003), *Readings in Machine Translation* (pp. 13-17). Cambridge, Massachusetts: The MIT Press.

Wood, L. (2002). The World in a Box. *Scientific American,* January 2002 Issue. Retrieved July 17, 2004 from http://www.sciam.com/article.cfm?articleID=00063887-5C1E-1C6D-84A9809EC588EF21&sc=I100322

Zhong, W. (2003). An Overview of Translation in China: Practice and Theory. *Translation Journal*, Vol. 7, No. 2, April 2003. Retrieved July 30, 2004 from http://accurapid.com/journal/24china.htm#2'